X Rays Probe the Atom • • More About Pluto

"Blind" Flying • • What is a Quantum?

SCIENTIFIC AMERICAN

December · 1930

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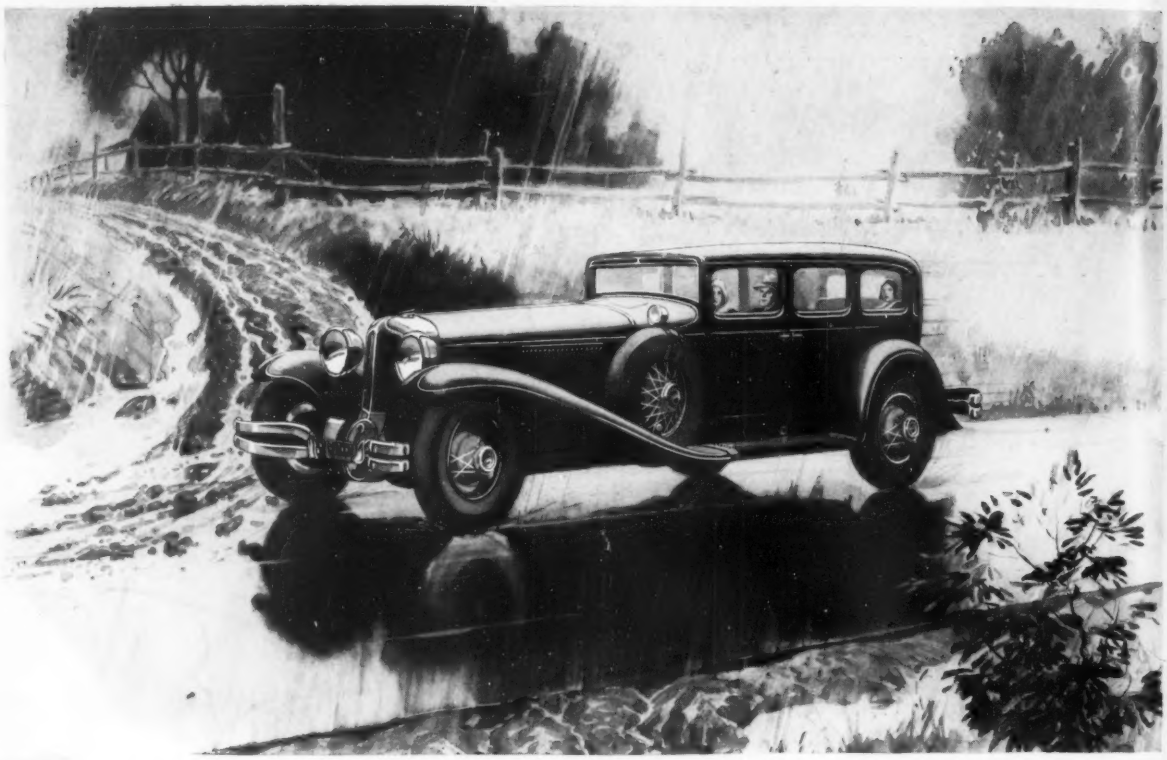
PROF. R. W. WOOD DEMONSTRATING THE NEW "RAMAN EFFECT" IN PHYSICS



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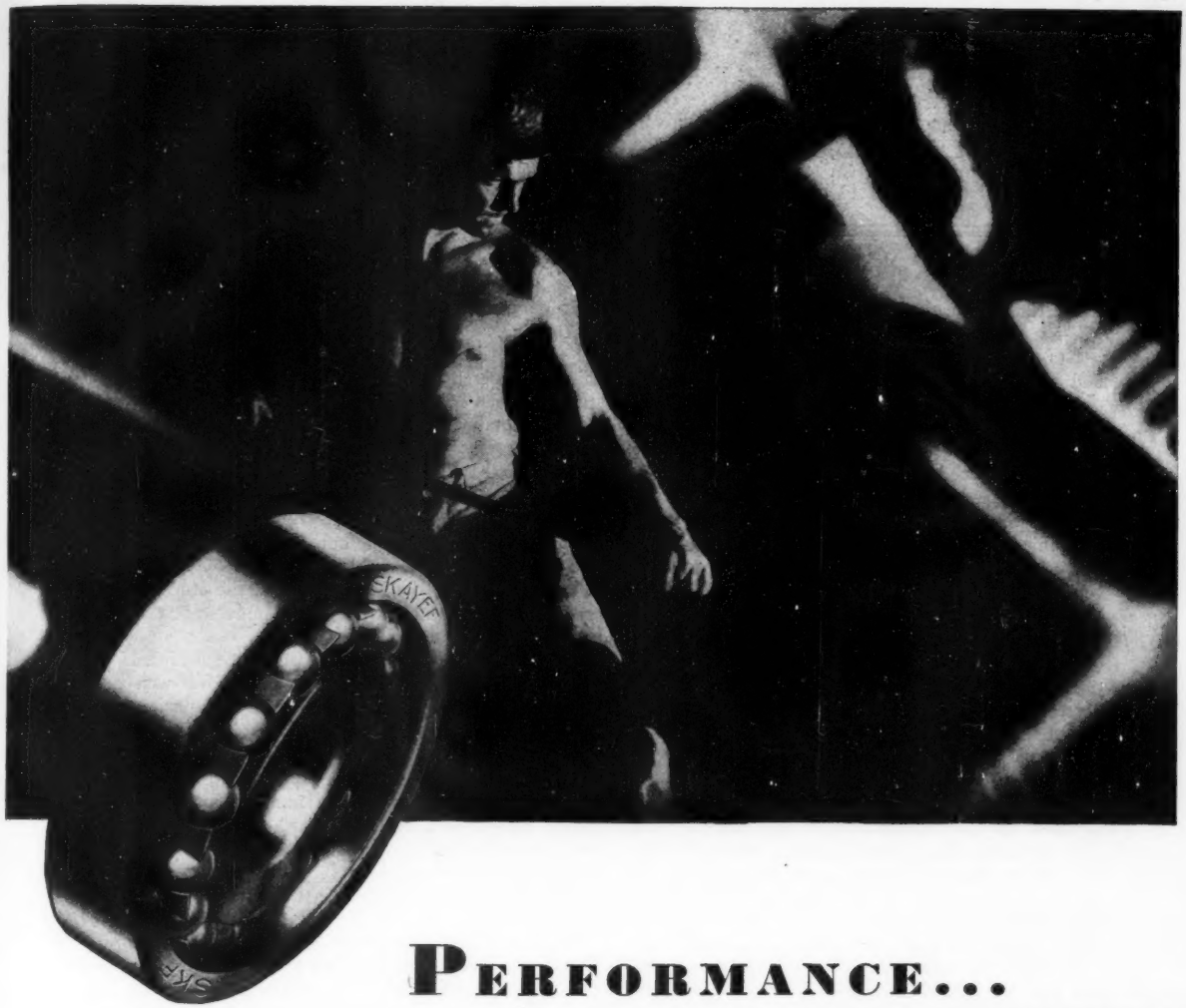

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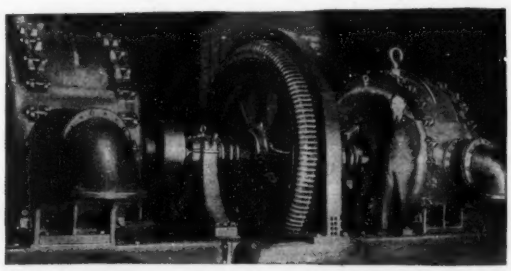

Performance was the thing that inspired the choice of SKF Bearings for these giant pumps, made by the Nash Engineering Company of South Norwalk, Conn. Photograph illustrates the largest vacuum pump installation in the world.

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ACROSS THE EDITOR'S DESK

THE welcome that was accorded our November issue, in its new format, was most gratifying to us, confirming as it did our editorial policy and opinion. After the rush that always attends going to press, we sat back in our chair and looked over the advance copy with critical eye. Frankly, we were pleased with the result, and now many of you have voiced the same thought. We thank you, and want you to feel that we always welcome the opinions of our readers.

In this, the last issue of 1930, we present a selection of articles intended to appeal to the most diversified tastes. Pure science, never as "heavy" as it would seem at first glance but detailed and informative just the same, takes up perhaps a third of the issue. Industrial subjects, engineering, aviation, and criminology are covered. As a sort of dessert, there is included an article on feeding the crew of a battleship which contains some amazing statements by a sailor who has a faculty for making his readers at home in the subject which is his life work.

When Dr. Paul R. Heyl was in our office a short time ago discussing various matters, we asked him to give our readers something to think about. He suggested an article on the quantum, and in this issue we present his views on this intriguing subject. He has even told us how big a thing a quantum of starlight is—about like a barrel. Yet a quantum can get into your eye. How does it do it? Nobody knows. Science frankly admits it doesn't yet "know it all." Many things remain to be found about the quantum.

Sir William Bragg, famous British scientist and winner of the Nobel Prize, shows how man, in overcoming the difficulties presented to him by the things which help him up the road of progress, has devised ingenious methods to aid him in his task, finally discovering the use of X-ray "fingers" for feeling out the atomic structure of matter. He says nothing of those who actually developed this new tool of science but those who are on the inside know that "they" were largely Sir William Bragg!

From Peiping—late Peking, Capital of China—came the article "A 4000-Year Food Experiment," a study of the nutritional equilibrium that has been achieved by China and of the economics of food supply of that overpopulated country. The author, Dr. Adolph, is an American professor in Yenching University, most of the funds for which were raised in America.

Fog, that dread enemy of the airman, is slowly being conquered by new educational methods for student pilots. Major William C. Ocker (promoted from a captaincy since his article was set in type) tells in interesting detail why it is that "flying sense" has often led to crashes in fogs, and what steps are being taken to educate pilots *not* to "use their heads" but their infallible instruments instead.

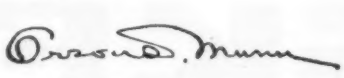
Professor R. W. Wood, our contributing editor who is famous in the field of physical optics, reviews in this issue the background of the study of scattered light and explains in understandable language the famous Raman effect.

To start the New Year right, we have scheduled several exceptional features. One of these was written at our request by Professor Humphreys, America's foremost meteorological physicist, to answer the question that has been put to us by so many practical people: "If they do succeed in sending a rocket 50 or 100 miles into the air—what then?" He tells in a straightforward, satisfying manner what scientific instruments the Goddard exploring rocket will carry, what facts they will record, and what scientific and practical significance these facts will have.

What is life? No one knows. We may never know. But now a Mexican man of science believes he has produced living substance out of the non-living. If his experiments, as described in a coming article, are verified by other scientists, the work will rank as a legitimate scientific sensation. Readers will do well, however, to keep an open mind on the matter for the present.

Coming also is an article to follow up that by Sir William Bragg in this issue. Written by Professor Pullen, also of England, it deals with the practical application of X rays in determining the structure and qualities of alloys used in engineering.

Besides these, there will be in the January issue an article concerning the tremendous developments of modern "alchemists," those who carry on research in the base metal iron and make of it alloys that are "noble" in their strength and utility; one on the fascinating ivory industry; others on aviation, engineering, and oil; and the usual choice selection of smaller articles in the SCIENTIFIC AMERICAN Digest.



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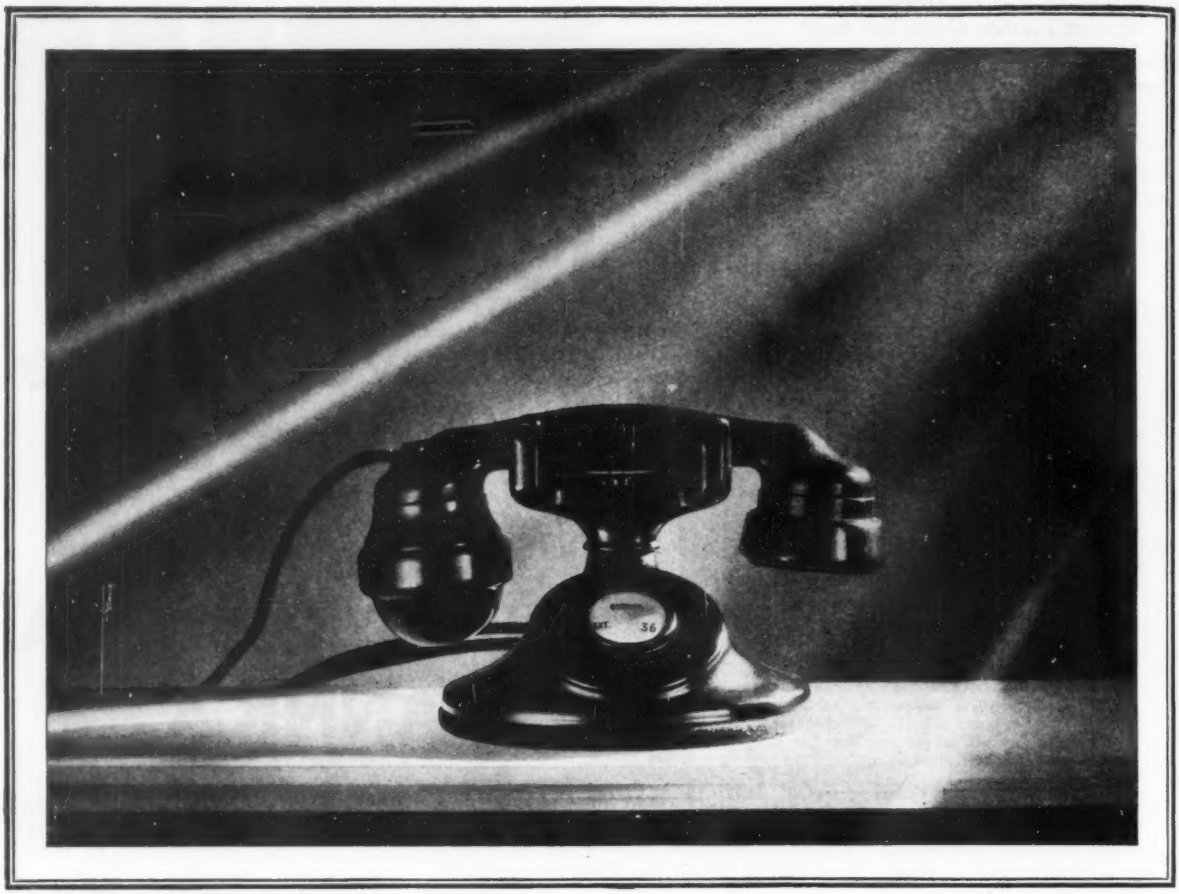

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EIGHTY-SIXTH YEAR • ORSON D. MUNN, Editor

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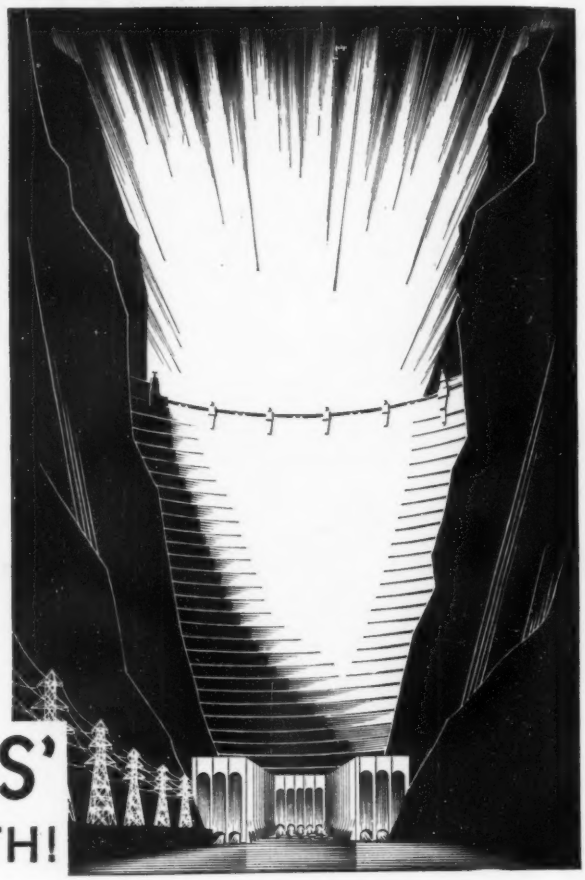
THIS MONTH'S COVER

The painting reproduced on our front cover relates to the article on page 452, and gives an accurate impression of a new experiment which has revealed an interesting phenomenon in physics. At the extreme right is a mercury arc lamp shining through a narrow window. The light passes through a tube containing a solution of iodine in iron tetrachloride (whence the tint suggesting grapejuice) and into the attached tube containing the liquid under investigation. This is blue when illuminated because the molecules of the liquid in it are just the right size to scatter the wavelengths corresponding to blue. Beneath it is a prism which reflects the blue light from the tube above, at right angles (horizontally) into a spectroscope having on the eye end a photographic plate.

STARTED!



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Secretary of the Interior, RAY LYMAN WILBUR, *said regarding the future benefits of the Boulder Canyon project:*

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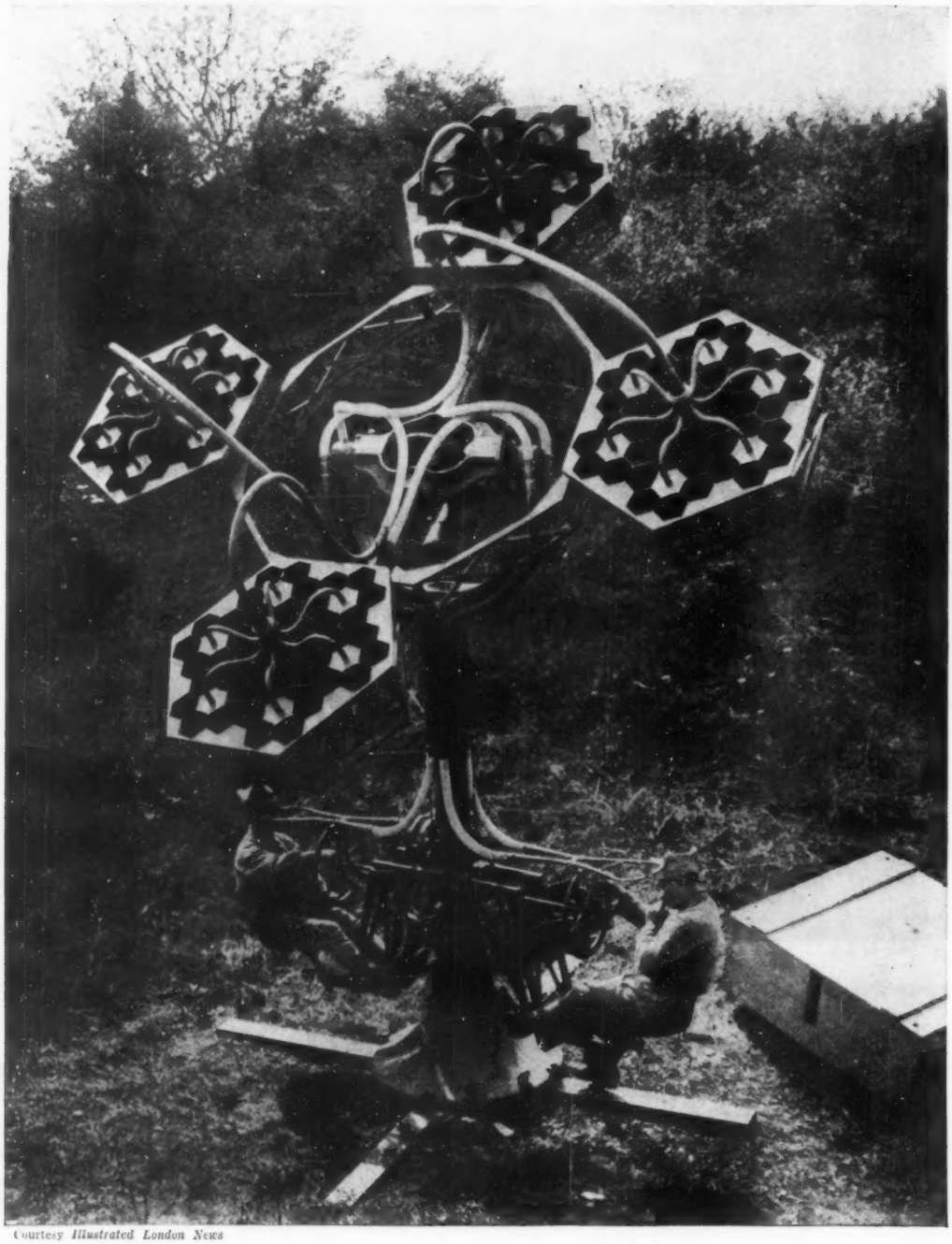
Photo by Troy

TWO SURVIVING PIONEERS

THE first dynamo built in America, like the surviving one of the two Cornell professors who built it in 1875, still is in perfect working order at Ithaca, New York, where it furnishes power to the students' shop in the physical laboratories of that institution. "In 1875" says the physicist Edward L. Nichols in the *Cornell Alumni News*, "Gramme brought out in Paris his form of dynamo machine, and no sooner had the description of it reached this country than Anthony and Moler (Professor W. A. Anthony and Professor G. S. Moler—the latter appears in the picture, which is recent—Ed.) undertook to build one. Long before the first imported dynamo reached America this machine was successfully completed and in operation. With it, before the close of the year, arc lamps were installed on the Cornell campus and were put into regular service, and thus it came about that inhabitants of remote farms among the hills of central New York saw the arc light shine out nights, years before the introduction of this means of illumination in Paris, Berlin, New York, or any of the great cities of the world." Professor Moler told a member of the SCIENTIFIC AMERICAN staff that he and Professor Anthony were forced to wind all the wire with home made insulation. Insulated wire was not available in 1875. The wiring of the outdoor lighting system was underground and the cables were made by drawing copper wire through gas piping and pumping tallow into the pipes, a method which nevertheless proved very satisfactory.



Courtesy *Illustrated London News*

NEW "EARS" FOR FRENCH ANTI-AIRCRAFT GUNNERS

TO keep pace with the great strides made by military aviation since the war—that has been the problem of the anti-aircraft sections of the artillery of all nations. The efforts of the French to do this are symbolized by this new device, by means of which ground crews listen to the approach of an enemy plane, "focus" upon it, and determine its position and altitude. While no details have been released concerning this apparatus, which was tested in recent French aerial maneuvers, it is said to register the sound of planes 20 miles distant. Although aero-detectors have been demonstrated before, this one is interesting because of its novel construction.

Plowing in North China. A man is often a more economical draft animal than a mule

A 4000-YEAR FOOD EXPERIMENT

By WILLIAM H. ADOLPH, Ph. D.

Associate Professor of Chemistry, University of Nebraska.
Recently appointed Professor of Chemistry, Yenching University, Peking.

THE average Chinese lives on but a few cents a day. This is not a myth, nor is it a sign of poverty; it is a simple statement of an economic accomplishment of which China may justly feel proud. We in spendthrift America should at least stop and honestly study China's sane solution of her food problem.

The brief experience of the Occident becomes ridiculously insignificant when compared to the 4000 year experiment which the Orient has conducted on the feeding of large numbers of people. In present day laboratory studies the scientist measures the nutritive value of a diet by feeding tests upon a small colony of perhaps ten or a dozen caged animals. The experiment is brought magnificently to a close after 30 or 40 days, during which the white rats for example have grown or failed to grow on the diet in question, and the conclusions are pronounced with due finality; only recently has it been realized that laboratory feeding experiments must often extend over not only several days, but over several generations before satisfactory conclusions can be drawn.

But here in eastern Asia is a colony of 400,000,000 people who in response to various environmental factors, and possibly racial factors, have adjusted and readjusted their food habits until the present *status quo* was reached! And this condition of established food habits would seem to have remained unchanged for the last thousand years or more.

We, with our new civilization, are still undergoing adjustment to new environmental and economic influences and have not yet reached a state of stable equilibrium. In laboratory experiments, a nutritional equilibrium such as the Chinese would seem to have attained is exactly what the biochemist seeks. The thoughtful nutrition chemist loaded with the faddist lore of the Occident can not but sit as a humble observer before this long term experiment and its accumulated mass of evidence. The Chinese would seem to have sensed certain fundamental principles of food supply long before they were discovered by the up-start West.

The Author

CHINA from ancient days has been an agricultural country, and it is still essentially agricultural. Certainly less than 10 percent of the population are found in the large cities and even these are mainly engaged in trade or industry involving agricultural products. The encroachments of the new industrialism may soon begin to alter this state of affairs, but so far there has been little measurable change. The majority of the people eat what they raise. China continues to feed herself largely in terms of a hand-to-mouth operation. The very thoughts of the people, and the language background, are agricultural. A man's wealth in China is expressed not in dollar marks, but in acres of land. An institution in America may possess an endowment of so many million dollars; in China it is endowed with so much land.

The race for the almighty dollar becomes in China the struggle for land, and this in time produces population pressure. The American and European can calculate the amount of money needed to feed and clothe each member of his household per year. The Chinese glibly reckons this factor in terms of land area, or *mow*. In Shantung, it requires three *mow* to support one man; or, poorer land would be rated as four-*mow* land.

This situation means that practically every available plot of land is under cultivation. Farms may be little more than a single furrow or two hanging on the mountain slope. It is significant that

TABLE I

Composition of the Chinese Dietary
(in percentages by weight)

	China North	United States
Cereals and beans	65	25
Vegetables and fruits	27	20
Butter; fats; sugar	1	14
Meat and fish	4	18
Eggs	1	5
Milk and cheese	0	15
Other foods	2	3

the size of a family is commonly expressed as consisting of so many "mouths," much as industrial Europe and America refer to so many "hands." The primary aim of each household is to work that bit of land intensively enough to keep the family alive for another half year, or until the next harvest. Ambitions in the big majority of homes do not proceed very far beyond this sphere. This tremendous pressure for a livelihood is not a condition of recent years, but history shows that in very early times there were laws in China regulating the conservation and distribution of food. Our science of national food economics, urged upon us by the World War, is hardly a 20th Century discovery!

A Chinese highway eighteen inches in width effects a saving in land area available for cultivation, which means food for more mouths

TABLE 1 shows the character of the middle class Chinese diet compared with that for the United States. It is a cereal diet. While these figures are for north China, they are in general true for south China also, except that in the northern third of China the cereal is largely wheat, used as wheat bread, while in the southern two thirds of the country the cereal employed is rice. The common assertion that the Chinese live on rice is therefore only two thirds true. The division into north and south China, that is, a wheat-eating region and a rice-eating region, is a well-recognized one. Habits of life, climate, and agricultural conditions in these two areas also differ greatly. North China has a dry climate; south China is wet. Data now being accumulated for south China, while as yet incomplete, indicate that the only real difference between the dietary of the two areas is in the replacing of wheat by rice. The same fundamental laws of food economics hold throughout the country.

The important place occupied by legumes (this means the soy bean) in China deserves more than passing mention. Of all the varieties of beans, it is nothing short of remarkable that the Chinese farmer-dietitian, thousands of years ago, chose to develop and retain in his agricultural repertoire just that one variety which contained the highest percentage of protein, and also the highest percentage of fat. The soy bean was the one vegetable product which could in any sense replace meat in his dietary. But the soy bean and its wonders is another story.

It is evident that China is not addicted to the meat eating evil. Table 2 shows that the daily food intake represents a total of about 2800 calories. But of this amount, 87 percent is derived from cereals and beans, while only five percent of the calories is supplied by meat and fish. And these data do not represent the farmer class, but are those of the middle class Chinese. Meat is relatively more expensive in China than in America and Europe. The peasant farmer consumes practically no meat at all, except for an occasional indulgence at the time of the Lunar New Year. It is probable that the Chinese approach as near to being a truly vegetarian people as is to be found anywhere on the earth's surface.

Figure 1 is a "dollar diagram" indicating the manner in which the average Chinese family divides its expenditure for food. The Chinese housewife very evidently spends her food dollar in a different manner than do we. It is to be noted that eggs are used only in small quantities; milk and dairy products are conspicuous by their absence.

Meat and cereals are important because of their protein content. Protein of course is the all-important nutritive factor of all foods. The nutrition chemist of a generation ago devoted his energies to determining the total number of grams of protein consumed by the individual per day. It was not then known that the kind of protein was as important as its quantity. We now know that the amount of protein is only part of the story. One hundred grams per day (about 35 ounces) is regarded as the protein requirement for the average adult in the Occident, weighing 70 kilograms (154 pounds). In America we actually consume far more than this amount; the Chinese consumes somewhat less. But when, in addition to this, it is remembered that a vegetarian diet is a much bulkier diet than the meat-containing diet of the Occident, and that the degree to which this protein is utilized in the alimentary canal may be reduced by the very bulk of the food to 50 or 60 percent of its original value, one realizes that the Chinese receives in reality an extremely small amount of protein nutrient daily. In fact, the actual intake for a man of 60 kilogram weight on rice diets may be only 35 or 40 grams (about 14 ounces) per day. This low protein diet again represents a habit of long standing. Have the Chinese indeed accommodated themselves to a lowered protein intake? And if it should be proved that they have done so successfully, perchance the figure for protein requirement which we have established will need revision.

DIETARY surveys show that 91 percent of the protein consumed is of vegetable origin, while nine percent proves to be of animal origin. In America about 80 percent of the protein consumed per day is from animal sources. Much has been written on the relative merit of animal and vegetable protein, of the meat *versus* the vegetarian diet. It is commonly suggested that the aggressive peoples of the world consume large quantities of meat. Table 3, taken from Robertson's "Principles of Bio-chemistry," expresses quantitatively the meat eating habits of the nations. The figure for China has been added to this table by the author and is based on

TABLE II

Composition of the Chinese Dietary

Intake of protein, total energy value, and so on, per man per day (Figures are for North China).

Total food	1188.0 grams
Total protein	86.4 "
Total fat	34.1 "
Total carbohydrate	537.0 "
Total energy value	2794.0 calories
Weight of average man	60.0 kilos

observations in Chinese homes and on such trade reports as were available. One wonders whether it is possible to explain certain of the racial characteristics of the Chinese in terms of this low per capita consumption of meat.

That a vegetarian diet rather than a meat diet holds sway in China can be traced to economic factors. The food-consuming animal is a mechanism which transforms food energy into heat or work or even into other forms of food, as into meat for example, which can again be used as food; the animal body, in short, is a converter. Studies in this country during recent years have shown the relationship pictured in Figure 2, which indicates that the transformation by cattle of food cereal into milk or into meat is always attended by considerable loss, a "transformer loss." China in her unconscious way has realized this. At least she has realized that the cereal grains are most economically employed directly as human food.

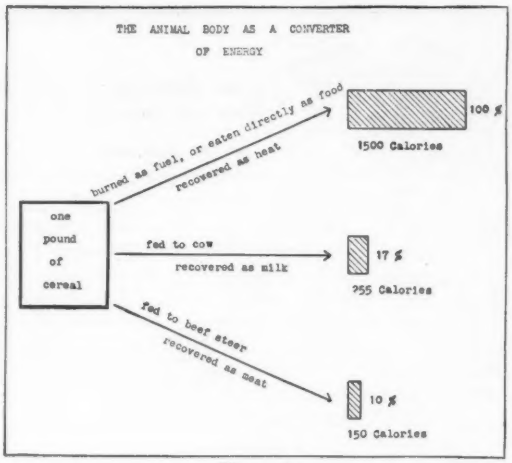


Figure 2

AND yet this knowledge is not solely unconscious knowledge, for the peasant farmer will tell you that he can obtain a greater return per acre by growing peanuts and extracting the peanut oil than by pasturing a cow in this same field and manufacturing butter or cream—which is merely another variety of oil—from the milk. In fact he knows this so well that for the past thousand years or so he has not even regarded it as worth while to perform the experiment. Just here, incidentally, lies the economic stimulus for our own vegetable oil industry. And we of the West have just come to the stage of measuring these things and have discovered that they are quantitatively true. Do we wonder that China eats little meat and that there is practically no dairy industry!

And the Chinese use of pork is equally startling. Only recently has it been demonstrated by modern science that an acre of ground in the form of pasturage produces two pounds of pork for every pound of beef or mutton. So when meat is used in China, it is pork. The laws of economics have dictated far more of the actions of the Oriental than we realize. A man instead of a horse pulls a ricksha because a man is a machine weighing only 60 kilograms and its cost of maintenance is less than that of a horse which is, say, a 600 kilogram machine.

In times of special stress affecting the food supply, such as may be brought about by famine, the farmer tends to dispose first of his draft animal, a luxury. Even when there is no famine at all, it often becomes more economical to hitch a man to a plow than to use a mule. The one-wheeled cart, which requires only a narrow, 18-inch-wide path for its operation and thereby saves more tillable land to the fields on each side of the road, is but another instance of the manner in which economic laws hold the commanding position.

Blind experiment, that guiding angel of the Orient, was kind. It taught the Chinese the importance of vitamins, or at least the importance of vitamin-containing foods. Today, recognizing the importance of vitamins and similar food essentials, we wonder that China not only survived but flourished on a straitened food supply. But China has long been making use of green vegetables, spinach, cabbage, and so on, and fruit. And we of the Occident, having just discovered vitamins, are now busy haranguing our housewives and urging greens in the diet—and often with ill success. Wheat protein and rice protein are now known to be incomplete proteins, but recent American patents suggest that wheat protein should be supplemented with soy bean flour. Effective combinations like this were in fact *discovered* by the allied food experts during the World War and were served to the soldiers at the front in the form of "war bread." China, on the other hand, has for centuries been making use of similar combinations of protein food materials. In addition to this, infants deprived of the nourishing protein of cow's milk are insured the growth-promoting essentials by being breast-fed till three or four years old.

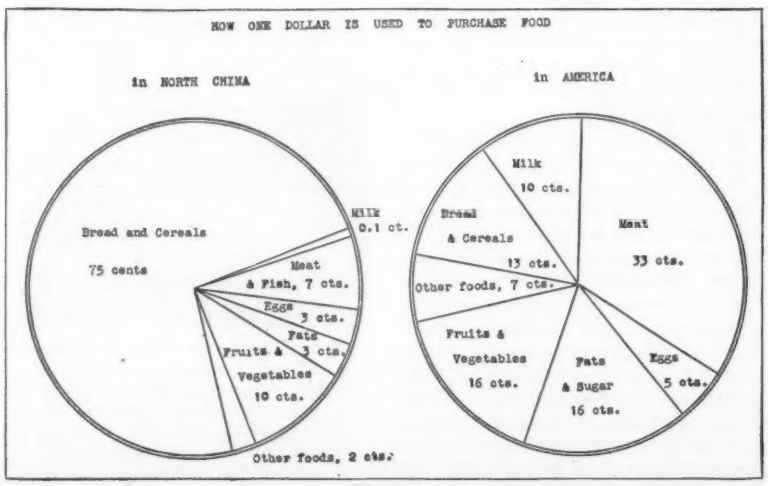


Figure 1

THE great bulk of the Chinese vegetarian diet is often looked upon by us with suspicion. It is such a considerable factor that the Chinese student coming to America finds it difficult to adjust to the smaller bulk of our more concentrated mixed dietary. He asserts that a period of a month or more is required till the digestive system accommodates itself to our small bulk meal. During this period of accommodation of course he finishes each meal with appetite still unsatisfied, and goes hypothetically hungry. We of the West formerly asserted that our type of diet was more concentrated and hence more efficient. But our own dietitians now urge roughage—and more roughage. The Chinese diet however, means a freedom from the multitudinous intestinal disturbances which affect the Occident. Laxative pills are not every-day essentials, and druggists in China must look elsewhere for means of livelihood.

Does the Chinese metabolize on a more efficient plane? Much interest has developed during the past few years in the basal metabolism of the peoples of eastern Asia. A few years ago an experiment at Teachers College, New York, upon a few Chinese women students indicated a much lower basal metabolic rate than would have been expected in the case of American women

students. The basal metabolic rate, about which our physicians are beginning to talk in such familiar terms, is nothing but a measure of the energy required just to keep the human engine alive at rest without doing work except that involved in breathing and the other essential functions. Does this lower figure mean, the physiologists all asked themselves, that the Chinese human mechanism is a more efficient machine than that of the European and American? Does it mean, asked the nutrition chemist, that the Chinese people need less food to keep them alive than their American neighbors of equivalent weight?

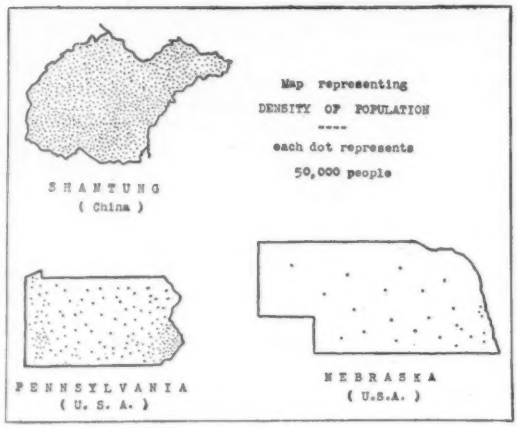


Figure 3

More exhaustive data is now being obtained; portable metabolism outfits have been sent by the Carnegie Nutrition Laboratory of Boston to different parts of the world to settle this point as it applies to the different races. It may be suggested that the lower figure for basal metabolism is the normal for the human race, and that the rush of the Western civilization has merely produced a higher metabolic rate in the Occident, while the philosophic Orient has avoided this abnormal high tension effect. Or the low metabolic rate for China, if confirmed, may merely indicate that the Chinese can truly live longer on a lower ration than is required by the European.

TABLE III

Meat Consumption of the Principal Countries of the World

(grams per capita per day)

United States	149
Great Britain	130
France	92
Belgium and Holland	86
Austria-Hungary	79
Spain	61
Russia	59
Italy	29
Japan	25
China (North)	15

Are metabolic traits inherited or environmental? The dietary and metabolic habits of a race presumably either are inherited or are the result of the reactions of environment. The very fact that Chinese leaving China and Occidentals domiciling in China find that certain physiological reactions are temporarily altered would point strongly to environment as the influential factor. North China and south China each represent different types of climate and diet, and when the southern Chinese migrates to north China and adopts north China food, his sons begin to approach in height and weight the higher standards of the northern part of the country.

Environmental factors often do not reveal themselves in a single generation. The Japanese who settled in the United States a generation ago are now developing a larger physique approaching western standards. Cantonese from south China who emigrated to Hawaii are now, after several generations, attaining greater physical height than they did in south China. The blood pressure of Americans moving to China approaches the lower Chinese standard, while Chinese coming to America tend to approach the higher American norm, while the basal metabolism itself of the Westerner moving to south China is apparently lower than it would be at home.

MANY different races now compose the white population of the United States, yet we generally agree that the same physiological standards hold for all of them; at least there have not been discovered among them distinct racial reactions of a purely physiological character. The so-called racial characteristic as distinguished from the environmental factor would therefore seem ultimately to disappear in the realm of food and metabolism.

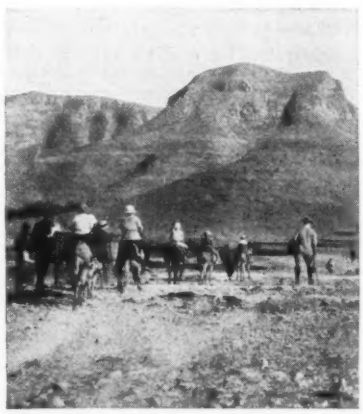
While it may be a distinct accomplishment to have been able over long periods to feed a nation on a minimum food intake, this habit of merely maintaining an existence has provided no insurance against interruptions in the regular food supply. The tables and figures reproduced in these pages indicate that the Chinese people live constantly on the fringe of starvation. There is absolutely no margin or reserve. A famine in China is primarily a violent disturbance of the delicately balanced economic *status quo*—so violent that the common people find it difficult or impossible to buy food. Drought, floods, grasshopper pests, revolution, are disturbing agents. And they are usually augmented by ill-developed means of communication, such that the areas with excess food supplies can not automatically unload their surplus unconsciously, as is done in America, on the regions where the demand is high and the supply low. One crop failure in a district brings about enormous suffering; two crop failures result in famine and starvation; and three successive crop failures in the same district produce havoc and devastation.

MOREOVER, human beings in China do not always die of starvation to the extent that they die from disease caused by a weakened physical condition. Food intake and health are closely related and famine studies show how a very slight lowering of the quality and quantity of food intake produces immediate disaster.

China, while receiving credit for a finely balanced solution of her food supply problem, is at the same time face to face with the fact that the prosperity of the nation demands not mere maintenance, but an optimum metabolism expressed in terms of improved growth and vigor. It is hardly to be doubted that in this modern age, with its new demands, China will rise to a solution of these newer problems with all the thorough-going capacity which she has displayed in the past.

●

When Professor Goddard's exploring rocket soars 50 or 60 miles aloft what scientific instruments will it carry? What will be their purpose and what the practical value of their findings? Next month this will be explained clearly and simply.—The Editor.



One effect of population pressure: a deforested mountain in North China. Population pressure results in the unconscious discovery of some valuable methods, such as hogs as the most efficient source of meat, but the deforestation that also occurs is not one of these

OUR POINT OF VIEW

SPEND FOR PROSPERITY

UNTIL a few months ago, there was, among industrial and business men and all people of the thinking class, a feeling of optimism regarding the economic depression, an optimism not of the Pollyanna sort but rather of a constructive nature. Many splendid plans were advanced as possible means of stimulating business recovery but nothing much has been done toward adopting any of them. And now, even the thinking optimists, as well as the Pollyannas, have turned lugubrious pessimists.

What is the matter with the American people?—that "race" which is famed for and vaunts its ingenuity, industriousness, and ability to the world. They are not unaccustomed to slumps; they've had them before. Where is that comeback, that fight, that will-to-win, bear-for-punishment spirit? Are they, to whom the world looks for a certain amount of guidance and, unfortunately, with envy and hate sometimes, because they *have* possessed a progressive spirit and an acquisitive instinct—are they to be cowed, to admit defeat and wait for someone else to start the world back toward normal conditions? Usually only the mongrel dog slinks away, whining, with his tail between his legs.

The country is not in such a bad state, after all. September disbursements of dividends to shareholders were nearly 76 millions of dollars more than for September, 1929. There was a large increase in the number of dividends omitted and reduced, but the total disbursements were 475,094,394 dollars compared with 399,391,264 dollars in September, 1929. This can mean only one thing: that while many businesses have suffered losses, many others profited far more than they did before the slump. There may be drawn from this the conclusion that if some can prosper, others can at least make a new start and grow. But somehow it hasn't seemed to work that way.

Long-established and vital industries that have withstood for months the laments of the pessimists, have at last succumbed and inaugurated programs for retrenchment that are sure to have a devastating effect, not only because they will withdraw many millions from circulation but also because they will further lower the morale of all those who hear of them. And the distressing part of it all is that our greatest customers, the American workingman and the small-salaried office man, are always the first to feel each new blow. They are discharged in hordes without the slightest prospect of obtaining other employment. Their purchasing power is lowered, business suffers further, and old man "vicious circle" is at work again! And even the man with a job becomes frightened at the possibility of losing his source of income and hoards his money "against a rainy day"—more money out of circulation!

In a case such as this it is easier to diagnose than to prescribe. One thing is certain, however, and that is that the American people, collectively and individually, must start a veritable orgy of spending. They must stop hoarding for a while, stop being frightened, stop crying "hard times" and put money into circulation, thus creating a great demand for all sorts of things the manufacture of which will make the wheels hum again and bring a return of prosperity. Time enough, after that is accomplished, to save!

Along with others, we have given up hope for any real help from business itself, and now appeal to the individual. And if that individual is one of those who persistently passes the buck to the other fellow, who is always perfectly willing to "let George do it," we venture to say that if he doesn't cooperate this time, the other fellow, George, may get his job!

DANIEL GUGGENHEIM

IT is our sad duty to record the death of Mr. Daniel Guggenheim, capitalist, philanthropist, and patron of aviation, on September 28 at the age of 74. Known chiefly to the country at large as the donor of the Daniel Guggenheim Fund for the Promotion of Aeronautics and vaguely as a "copper king"—vaguely, because while his power was tremendous, it was quiet—his interests spread over the world like a far-flung empire.

Mr. Guggenheim's business ability and progressiveness brought continual success to his endeavors but as his power grew, so apparently did his humanity also grow. Identified with the early romance of American mining, expanding his interests to other fields, and ever persistent in his encouragement of scientific research in industry, he yet had time for art and music and flowers. He gave liberally yet quietly, dealt fairly with all, and was imbued with a public spirit that few could equal.

In the death of this valued citizen his friends have suffered an incalculable loss. But his greatness transcends the limits of ordinary personal friendship; in him was the warmth of a great soul, a warmth that radiated outward through contact with him and his philanthropies to touch thousands whose lives, expanded and made finer because of him, shall be his greatest memorial.

INTERNATIONAL AFFAIRS

The Deplorable Cut In Naval Personnel

WE are convinced that the recent announcement by the Navy Department of a contemplated reduction of 4800 enlisted men in the Navy will be a distinct disappointment to the American people, a large majority of whom are willing to be taxed for the support of the Navy. The unplausible attempt to connect this reduction with the provisions of the London Conference will not impose upon the general public, who were only recently told by the Administration itself that a large new building program would be necessary to bring our fleet up to the allowed treaty strength. Obviously, ships without men are useless, so the proposed cut means either that the Administration has no intention of building a treaty fleet or that it does not propose to man it after construction.

The accompanying statement that our fleet is to become a "training nucleus" will still further alarm our people who have been taught to believe that a large standing army is unnecessary because our fleet would be maintained as a sure and ready shield, behind which our skeletonized peace army could expand to war proportions. Now we are to have a skeletonized navy as well as a skeletonized army. The term "training nucleus" has a comely sound, but the American people have too long regarded their fleet as their first line of defense to be charmed by any new catchword, however beguiling.

We also fail to see the consistency of the Administration discharging 4800 sailormen in the present condition of unemployment, while at the same time it requests private employers to refrain

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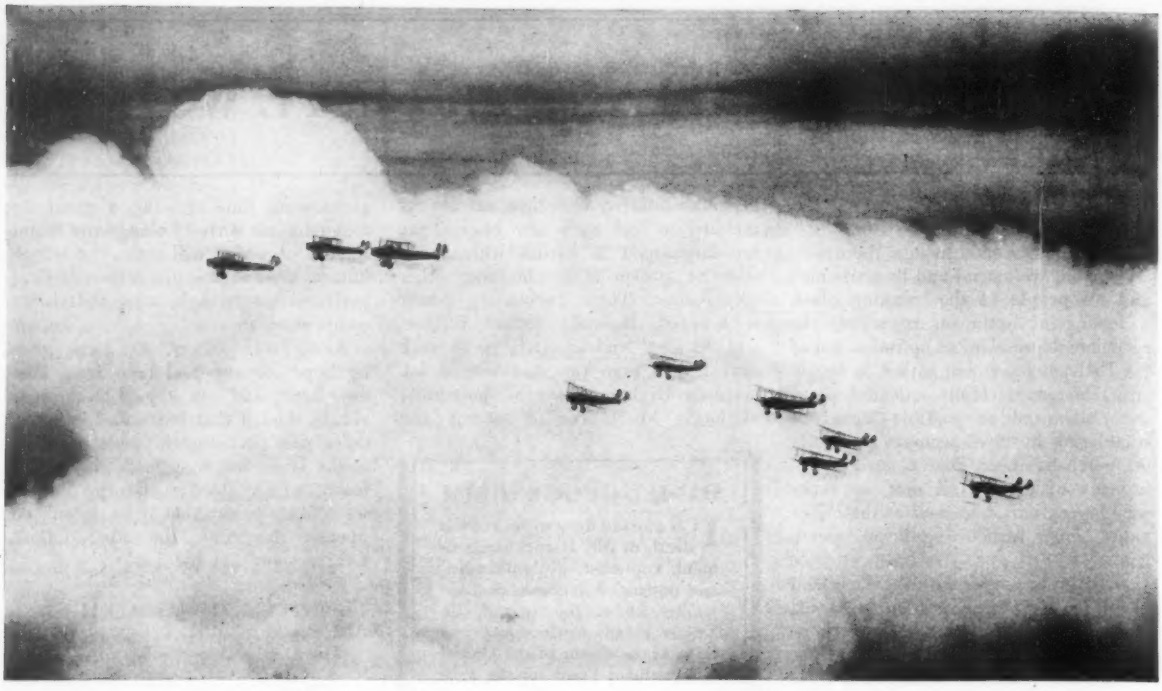


INSTRUMENT FLYING TO COMBAT FOG

By WILLIAM C. OCKER
Captain, Air Corps, United States Army

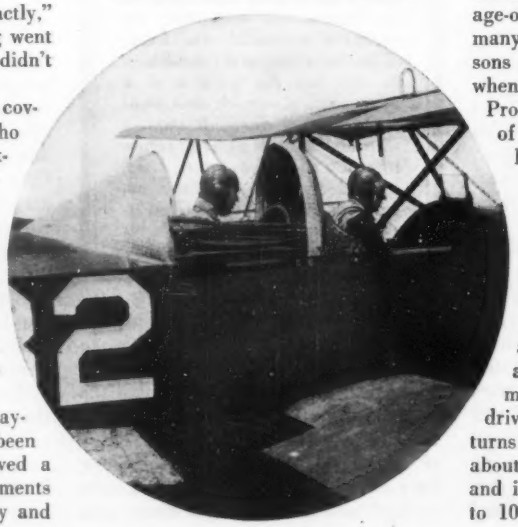
WHEN F. Trubee Davison, Assistant Secretary of War in charge of aviation, climbed out from under the covered cockpit of one of the planes used for instruction in blind flying on a recent visit to Kelly Field, he voiced the experience of many other pilots who have flown under covered cockpits or in fog, the actual weather condition which the covered cockpit simulates.

"I don't know what it was exactly," Mr. Davison said, "but something went wrong and when I tried to turn, I didn't know where I was."

It was the first experience in a covered cockpit for Mr. Davison, who has a reputation for being an excellent pilot; he was more fortunate than some other pilots in that he was thoroughly convinced beforehand that his instruments were going to be right and his senses were going to be wrong. Failure to realize this fact has resulted in many crashes, no small percentage of which have been fatal.

That the instruments went "haywire" is a report that has often been made by pilots who have survived a crash in a fog. Even when instruments were later returned to the factory and pronounced correct, the pilots were loath to believe in them, so strongly ingrained was the theory of "flying instinct," taught until recently in all flying schools. Science has performed another service in exploding this dangerous theory—that a pilot can "feel" the position of his plane in a fog when he cannot see.

Type of plane used for training in instrument flying at Kelly Field. The canvas cover slides over the rear cockpit, and head-phones permit communication between pilots



A comprehensive report by Prof. A. A. Schaeffer, of the Zoological Laboratory, University of Kansas, on "Spiral Movement in Man" seems to be the basis of the problem and may answer the question of why pilots go into a tail spin when they get into a fog. The age-old belief, found in the folklore of many races and nationalities that persons go around and around in a circle when they lose their way prompted Professor Schaeffer to conduct a series of experiments which led to the following conclusions:

"When blindfolded persons walk or swim in what they intend to be a straight path, 300 or more steps in length, they actually walk in a more or less regular clock-spring spiral. The same is true when driving an automobile blindfolded or when a blindfolded person in an automobile calls the direction to the driver. The diameters of the spiral turns in walking or swimming vary from about six meters to about 30 meters, and in driving an automobile from 12 to 100 meters. These spiral turns are

not due to any asymmetries in the legs or other parts of the locomotor organs of the body generally, such as right-handedness.

"ONE and the same person may walk or swim or drive both right spiral turns and left spiral turns in different experiments or sometimes in the same experiment. No apparent difference is observed in the direction of turning that is referable to difference in age, sex or right- or left-handedness. Spiraling is not a conscious phenomenon. Consciousness gets no direct repeat from the spiraling mechanism. A blindfolded person is conscious of swimming or driving a straight path when he is actually going in spirals. The spirals are smaller, however, when the attention is not intensely directed on the manner of making each step, but is occupied with counting the steps or thinking about something else than walking a perfectly straight path.

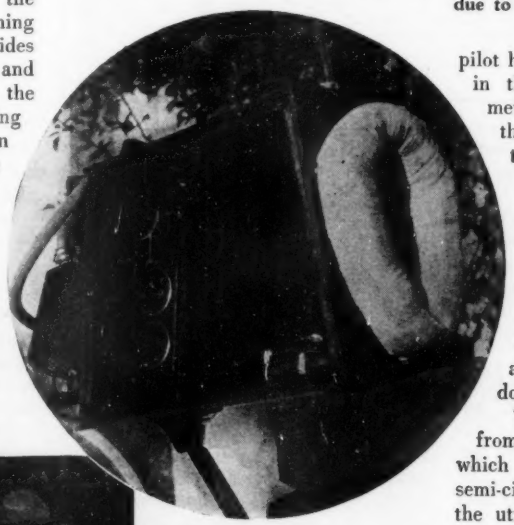
"Persons who lose their way in forests, snowstorms, and fogs go around in circles because, in these persons, the orientating senses are not functioning and then the spiral mechanism guides the path. Rabbits, foxes, antelopes, and other game, when hard-pressed in the chase, lose the power of orientating themselves through fear and then the spiral mechanism also leads them around in circles."

This tendency to move in spirals is not lost in the air. It is rather further complicated by the addition of a third dimension with which the pilot must cope. Professor Schaeffer's report and the experiences of many pilots while flying through fog lead to the belief that this spiral tendency may work in the third dimension and such a compound tendency may readily cause a plane to become tilted at almost any angle while the pilot still believes himself flying on an even keel. Under such a condition, while flying in fog, it would be quite possible for the plane to be tilted at a stalling angle without the pilot realizing it.

To correct this spiraling tendency and enable us not only to walk in a straight line but to maintain our equilibrium, Nature has endowed us with a number of senses, chief of which are the sense of sight, the vestibular sense, deep muscle sense, and the tactile sense. Tactile sense, or the sense of touch, is of considerable importance on the ground but in the air, with heavy clothing and within closed cabins, this sense is reduced to a minimum and plays only a minor and insignificant part and may be disregarded entirely so far as maintaining equilibrium or a straight course is concerned.

Deep muscle sense, often alluded to by pilots as "feel of the ship" or "seat sense," includes sensations resulting from stimuli from the muscles, tendons, bones, joints, and internal organs. The pilot has been taught to lay great faith in this sense. There is no known method for accurately measuring this sense but the thoroughly trained pilot appears to develop it and interpret the stimuli to a much greater degree than others. Deep muscle sense is far from being infallible in maintaining equilibrium, however; many pilots have come out of fog to find themselves off their course, with a wing up or down, and even with the plane upside down.

Captain Ocker and Major Mileau, flight surgeon, giving a test with the Barany chair. After a few turns in the chair with his eyes closed, the subject almost falls out of the chair due to effects of vertigo or dizziness



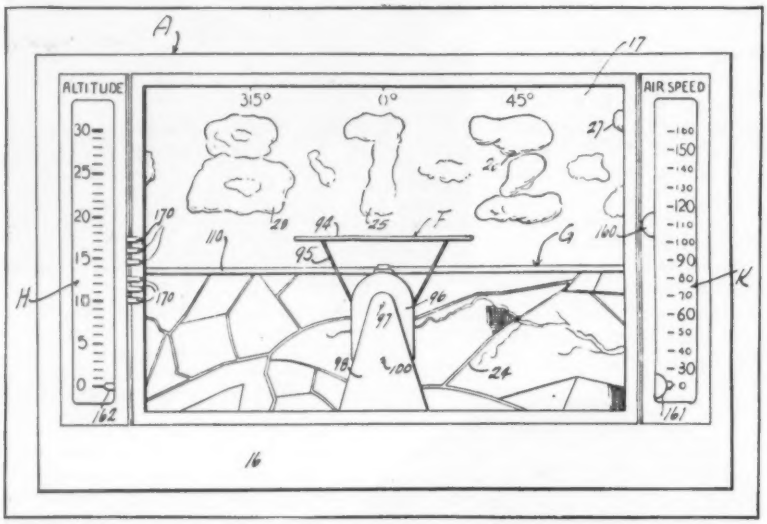
At right: **Close-up of instrument box for use with Barany chair to show illusions caused by vertigo.** ***Below:*** **Method of using instrument box with Barany chair. Slide removed in both cases to show instruments**

The vestibular sense is derived from that portion of the inner ear which has to do with equilibrium—the semi-circular canals, the saccule and the utricle. These are considered the chief motion perception organs and have been the subject of many investigations as being of great importance in flying. One of the simple tests which have been devised to indicate the accuracy of the vestibular reactions can be made with the Barany chair, a revolving chair with control attachments.

THE vestibular reactions are controlled by the semi-circular canals of the inner ear, which are at right angles to each other. By reason of their position, they are stimulated by changes of position of the individual and stimuli received by these organs are interpreted by the brain as sensations of motion. The stimulation of the canals and the reactions observed by rotation in the Barany chair are similar to those produced in actual flight, although the subject is not actually in a spiral dive or

tail spin. When rotation stops, the sensation of vertigo, or dizziness, results. If the subject in the chair is questioned after a few turns, it will be found that this sensation of dizziness is actually a sensation of rotation in the opposite direction to which he is being rotated. The individual has no control over these impulses.

Although it is known from actual experience in aviation and from experimental work that the erroneous impression derived from the repeated stimulation of the labyrinth of the inner ear is subject to decrease and duration, no normal person has been known to overcome this illusion entirely. The vestibular sense, then, is one of the senses which govern equilibrium, but without the sense of sight it not only is useless but is actually dangerous because of the illusions it creates. The sense of sight is important on the ground but is much more so in the air.



Flight integrator invented by Lieutenant Carl J. Crane and the author. At the left of painted landscape is the altimeter; at right, the air-speed indicator

THIS special sense is, of course, not infallible for there are such things as optical illusions—a mirage for example—but it is certainly the most reliable. Through sight alone are we able to take bearings on our position and calculate our approximate position in regard to a given point. So long as our sight is not impaired, we may reasonably expect to remain orientated.

Equilibrium in the air, then, depends first on the sense of sight, then on the vestibular sense, deep muscle sense, and last upon the tactile sense. In flying in fog, this sense of sight also fails as there is no fixed point outside of the plane, no horizon to aid in orientating the pilot. The solution of this problem is to have absolute confidence in the flight instruments, such as the bank-and-turn indicator, the inclinometer, and the rate-of-climb indicator. In this connection an interesting psychological problem arises.

Until very recently, all flying students were taught to disregard flight instruments and trust entirely to their "flying instinct" even in fog. As a result, pilots taking the blind flying training, flying by instruments under a covered cockpit, find it hard to disregard their instinct, which they are thoroughly convinced is a handicap without sight, and to trust their instruments implicitly. The older pilots at Kelly Field taking blind flight instruction learned less easily than the younger pilots or the flying students in whom the flying instinct theory had not been so deeply ingrained.

After the pilot has been convinced that he must disregard his instinct, instrument flying is principally a matter of co-ordination. He has been accustomed to moving his hands and feet in accordance with stimuli produced by a landscape at various positions relative to the nose of his plane. In instrument flying the stimuli are produced by various dials which must be read and interpreted before the controls can be manipulated properly. This mental process causes confusion at first but can be managed so that the average pilot can bring his plane out of spirals and spins and fly a triangular course of some distance with considerable accuracy after about 10 hours of training in the covered cockpit. Flying by instruments alone is more fatiguing than ordinary flying and also requires some practice in the covered cockpit when actual fog flying is not possible to "keep in training."

Several new instruments have been developed to lessen the strain on pilots who must fly by instruments alone, of which the Sperry company's directional gyroscope and artificial horizon are two. When a pilot wishes to make a turn of 90 or any certain number of degrees, the magnetic compass is unreliable because it spins when the plane is banked. The directional gyroscope does not spin and the pilot can tell immediately when the desired turn has been made. The artificial horizon shows the pilot the position of his plane relative to the horizon, indicating the angle the plane is banked and whether it is climbing or gliding.

THE flight integrator, invented by Lieut. Carl J. Crane and myself, is still in the experimental stage but gives promise of reducing fatigue and also decreasing vertigo caused by the rotation of the plane in a spin or power dive. It consists of a miniature plane silhouetted against a landscape painted on an endless belt. As the plane turns to the right, the background moves to the left, giving the pilot watching the miniature plane the illusion of turning similar to the impression he would receive were his vision not cut off by fog or the covered cockpit, as the case may be. Skidding or slipping is indicated by tipping of the miniature plane. A narrow white band stretched across the landscape rises above or falls below the horizon to indicate that the plane is gliding or climbing.

An altimeter reading vertically will be placed on one side of the integrator and an air-speed indicator at the other. Thus five instruments will be combined in one, making it unnecessary for the pilot to "chase all over the board" to figure out what the plane is doing, and the plane's movements will be shown directly, eliminating the mental process which is one of the chief causes of fatigue in blind flying. Vertigo is also minimized by the moving screen. When the plane stops turning, the screen stops moving and the pilot is able to orientate himself in a very short time.

The value of being able to fly in fog is readily apparent. It greatly increases military efficiency to be able to fly in all kinds of weather. As for the commercial field, it will increase safety and decrease the number of trips which must be cancelled because of bad weather, principally fog. Only one problem remains—that of landing in fog. When this is solved—and indications are that it will be, in the near future—the menace of fog which has long been aviation's most formidable enemy will be conquered.

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A railroad executive was intensely interested in the intricate details of railroad signalling systems as described in an article soon to be published. We warrant you will be, too.
—The Editor.

ELEVATED HIGHWAY TO SPEED TRAFFIC

WHAT will be the finest, and perhaps the greatest, highway of its kind in the world, is now under construction in New York City. Built along the Hudson River waterfront, this highway, which may be listed as one of Borough President Miller's important achievements, begins at the Hudson Tunnels at Canal Street and will extend to Spuyten Duyvil, a distance of 14 miles. The lower section, up to 72nd Street, will be elevated 14 feet above the street level. From 72nd Street, it will be a beautiful boulevard covering the tracks of the New York Central Railroad completely.

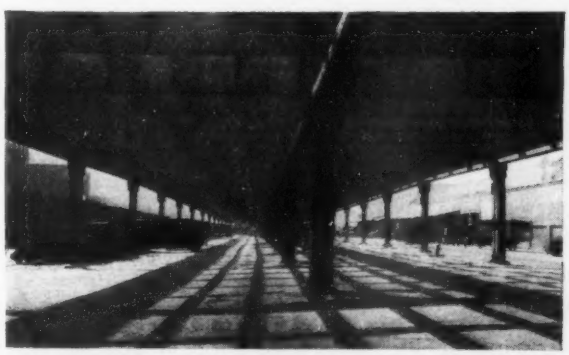
Ramps will be provided at 23rd, 42nd, and 57th Streets, reaching the center of the elevated roadway so that no cross traffic will occur. This will permit a speed of 40 miles an hour, resulting in a traffic capacity of 5000 vehicles an hour. Approaches will be constructed at nine uptown points, beginning with one at 72nd Street. The roadway will be 60 feet wide to accommodate six lines of traffic and will have the most modern signal system for traffic control, fire and police protection. The architectural design will take care of the esthetic as well as the practical values of the structure.

The entrance ramp of the elevated highway at busy Canal Street

Cars coming up either of these ramps pass directly into the traffic stream

The first section between Canal and 22nd Streets is now nearing completion and may be opened for traffic before this article is printed. Construction of this section involved many difficulties, one of the worst of which was the building of concrete foundations for the 400 columns in waterfront land that was filled in years ago with all kinds of waste materials, soil, and stones.

This great structure will aid greatly in solving New York's north- and southbound, long-distance traffic problem. It is understood that the plan calls for double-decking some time in the future.



Fourteen-foot clearance of the highway on a broad street

Nearing completion: lower section with paved roadway

X-RAY FINGERS FEEL OUT THE ATOMIC STRUCTURE OF MATTER

By SIR WILLIAM BRAGG, F.R.S.

Director of the Royal Institution of Great Britain and of the Davy-Faraday Research Laboratory.
Nobel Prize Winner. Author of "Concerning the Nature of Things"

MAN, having the power to forecast the result of overcoming difficulties and the wish to try to overcome them, has devised various ingenious methods to help him in his task. Taking first of all the difficulties that depend on the inadequacy of his vision he has invented the microscope which gives him the power of seeing details thousands of times too fine to be perceived by the naked eye. The spectacles that many of us use may be looked on as making a small step in this direction.

The power over the handling of materials has been enormously increased by the microscope. It has been the chief instrument in the study of metals and alloys, so that whole new branches of metallurgy and metal working have depended upon its use. It is fundamental to the study of the minutiae of fibers, so that textile industries depend on it more and more. It is, of course, the main weapon of the biologist and the bacteriologist upon whom so many sciences rely, such as agriculture, and all the economic development of plant life. In fact the microscope has immensely increased our powers of perceiving the small things and invisible conditions which must be treated sometimes as dangers, sometimes as objects of welcome usefulness. It has widened and enriched our world.

BUT there is a point which the microscope can not pass. With its aid we perceive what is very small, but not the "very very" small. There are regions of minuteness which it can not ever penetrate. The limit is set by a curious natural barrier; natural because it depends on the nature of light. If all the small things which mattered to us were contained within the barrier, there would be no need to try to surmount it, but this is not so. Wide as the fields are which the microscope has opened to us, far wider fields lie outside its range: fields which also contain events and things of first importance. There are details of the structure of the living cell, essential features in the composition of metals, cotton, silk, rubber, paint, bone, nerve, and a thousand other things which are hidden even from the microscope, and must always remain so hidden because the failure does not lie with the skill of the optician but with the incapacity of light itself.

Let us look a little more closely at this curious fact. The process of vision begins first with the emission of radiation from some source. Without illumination nothing can be seen. The nature of radiation is in many respects a mystery, but we know enough about it to understand that we may talk of it in many of its important aspects as waves in some medium which we call the ether. The eye is an organ designed to perceive these waves. If we turn our eyes towards the source of radiation they are filled with the sense of light. If the radiation falls on any object, it is turned aside and modified in various ways. When our eyes are directed towards the object, they take in the modified rays, and we have learned by long practice to know, from these modifications, the nature of the object that has made them. That is "seeing."

THE central point of the process is the act of scattering and modification. Now waves have a certain wavelength, and common experience of such waves as may be seen, for example, on the surface of the sea tells us that an object which is very much smaller than the length of the wave has no appreciable effect upon it. The wave rolls past a cork on the surface without showing appreciable traces of modification, but a rock or the side of a steamer may actually turn it back again. In just the same way there may be objects which are so small that they can not affect a ray of light, and such objects are forever invisible in the ordinary sense. The length of the light wave which our eyes can perceive lies within a short range on either side of a fifty-thousandth of an inch. An object of such small dimension can indeed affect a light wave, but the parts of the object do not produce obvious separate effects, so that we can not do much more by the aid of light than merely detect the object as a whole. We can see nothing of its details. There are smaller objects which we can not even perceive.

Now such details and objects can be of fundamental importance, as we have already seen. What shall we do now?

The X rays break down the barrier for us, and admit us to this immense field in which we want to be. They do so by virtue of their character as light waves, 10,000 times or so smaller than visible waves, but of exactly the same nature. They have all the necessary characters for modification by the "very very" small objects on which they may fall. We have only to ask, then, how they may be used and perceived, for our eyes fail entirely to detect them.

It happens that there are various ways in which they can be registered. One of the simplest and most convenient is by the process of photography. The plate or film which is made sensitive to light can, fortunately, also perceive the X rays, though our eyes have not this double power.

So far, so good. But we should not be able to go farther were it not that nature builds her structures on certain most interesting principles. Let us look into this matter also.

WE can take the atoms as the elements of all the substances that we use or handle in any way. We know that there are some 90 kinds of atoms of which a few vastly surpass the rest in numbers; oxygen, silicon, and aluminum heading the list. A piece of pure iron contains nothing, of course, but iron atoms; the point of great importance is that the atoms are not merely jumbled together anyhow, but are arranged very perfectly according to a simple pattern which is not very difficult to picture. Suppose a pile of cubical blocks to be made so that they lie in rows in three perpendicular directions. Think of the corners of these cubes as points in space. Put an atom of iron at each corner, or perhaps one should say, at each point where eight cubes meet. Place also an atom at the center of each cube and allow the cubes to vanish. There the iron structure is complete.

The structure of a piece of copper is even simpler. The atoms are arranged as in a pile of cannon balls, just as they are shown beside the guns in the old pictures. The structure of a diamond is rather more difficult to apprehend from a verbal description; it may, however,

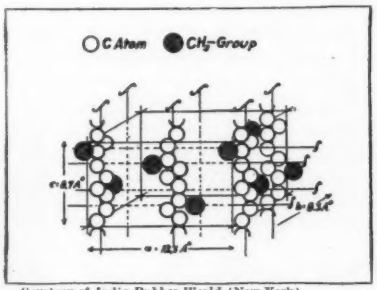
be grasped if it is remembered that each atom of carbon has four neighbors at equal distances from it and equidistant from each other. And so we go on to more and more complicated structures. The distances between the atoms are very small, we must remember; they vary about a mean of something like the forty-millionth of an inch. They are, of course, invisible, even in the microscope.

If a substance is such that all the atoms which compose it are arranged on one and the same pattern, so that the straight rows run through from side to side, the substance is a single crystal; crystalline character meaning, simply, perfect arrangement. Single crystals are, of course, common enough, such as jewels, salt, sugar, and a host of other kinds of substances, occurring, for example, in great frequency in the chemist's laboratory. But most substances, and especially those we handle every day, such as the metals, must be described as masses of small separate crystals. In fact a single crystal of a metal is rarely seen, and is a most curious object. A copper bar which is but one crystal throughout can be bent between finger and thumb like a piece of stiff clay. But in the very act of bending the complete uniformity disappears; the mass breaks up into small crystals. The bar loses its extreme plasticity and after a little handling becomes as stubborn as copper usually is.

THE fact is that in many kinds of crystal there are special directions in which planes can be drawn or conceived to be drawn, and the atoms on one side of such a plane can slide more or less easily over those on the other. They are called glide-planes. When the copper bar is one crystal throughout, it is easy to make this slipping occur. But when the bar is multi-crystalline, the planes of easy slipping are not the same for all the crystals, because the latter are oriented in different ways. However we try to deform the bar, there are always some crystals which resist being deformed in that particular way. And the various crystals back each other up according to some principle which we do not fully understand. Thus the properties of the bar depend upon its crystalline character.

The small crystals of which it is composed are often visible to the naked eye, and very often to the microscope. It is for this reason that the microscope has been of so much use to the metallurgist. But though the microscope can do and has done so much, it is only the X ray that can tell us the internal arrangement of the crystal, and it is only by becoming expert in the use of X rays that we can hope to unravel further the marvelous complexity of the relations between structure and properties.

If this is true of the simple metal, it is also true of the complex alloys, the properties of which are of such extreme importance in modern industry. We learn for example that iron, when treated sufficiently, changes the arrangement of its atoms to that already described as characteristic of copper. With this change its properties change also. If certain substances, carbon or manganese, for example, be added to the iron, the reverse change may be prevented, even when the temperature is



Courtesy of *India Rubber World* (New York)

The elementary unit of stretched rubber is found to consist of atom groups each about .00000087 millimeter in length, arranged as shown

once more brought back to normal. Thus the properties of iron in the second state may be retained and this is sometimes very desirable.

More generally the properties of an alloy depend not only on its composition but also on the nature of the crystals which the components form, on the sizes, forms, and relative orientations and dispositions of the crystals. And this is true, to some degree at least, of all substances. In fact, when Nature builds up a substance she tries always to put the atoms together in regular order and according to a regular pattern. The crystal is always arrived at. Generally, however, the attempt to carry the structure of a single crystal through the whole of a visible mass is only partially successful and not obvious. The X rays often surprise us by showing that crystalline structure exists where we had not expected it; for example, in cotton, silk, stretched rubber, bone, and so on, and we may be quite sure that the crystalline tendency is part of the plan and contributes to the desired character of the structure.

IN conclusion, let us now consider briefly the method in which the X rays are employed to examine the crystalline structure of any body. To describe it with any fulness we should have to use the diffraction principle of physics and other principles as well. But a general understanding can be reached by readers through less accurate means. Let us remember that to make any object perceptible by the use of radiation we must allow the radiation to strike the object which then scatters and, it may be, modifies that which strikes it. The scattered rays are received by the eye or the photographic plate or some other suitable apparatus. They are registered and we use our brains to judge by the result the nature of the object.

The X rays are of short enough wavelength to be turned aside or scattered by the atoms, when longer light waves are not. A single atom can, however, do very little. What apparatus we possess can only be effective if immense numbers of atoms act together. Here is where the regularity of crystal arrangement comes in. The unit of pattern is repeated an enormous number of times even in a crystal just visible to the naked eye. Whatever one of these units does in the way of scattering, all the others do in regular order. The combined amount is perceptible, and so the crystalline character is detected.

Sometimes we have watched a flock of pigeons flying over the town roofs in the evening and have seen that, as they wheeled, the sun's rays have flashed back at the same moment from the under surfaces of all the wings. Then the flock has for an instant been a notable object in the sky. The analogy is very imperfect, as everyone will see who knows the laws of diffraction, but it may serve to illustrate the method in which the X rays are used. The rays are made to fall upon the crystal which is turned about in all ways. Then at certain moments the position of the crystal is such that all the component units act in unison and a reflected ray flashes out from the crystal of a magnitude that may be perceived.

OF course this is an indirect way of examining the structure. We do not perceive the individual atoms; we discover only their arrangements. But the knowledge so gained can be combined with other knowledge that we already possess and we have actually found ourselves able to decipher the patterns of Nature to an extent we did not dream of a few years ago. We have a new field of knowledge, a new branch of science which is in fact the physics and chemistry of the solid. Its exploration gives us unexpected but most welcome information about the fundamental design of solid materials, organic and inorganic, living and non-living. It promises to fill a wide and serious gap in our previous knowledge and to give results of the greatest interest and importance in relation to science generally and in particular to the use of science in industry.

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¶ *In an early issue a more detailed article on the X-ray analysis of crystals, especially with regard to the study of engineering materials, will be published.*—The Editor.

A FACT-FINDING FACTORY

WE are frequently asked for information on testing laboratories that can be utilized for special problems by concerns and individuals who themselves do not have enough work of this kind to warrant the expense of maintaining their own laboratory. In response to the demand we present in this article the story of the availability and resources of a particular laboratory, as typical of the development along this line. Should you have problems of this kind we will be glad to give such information as we can.—*The Editor.*

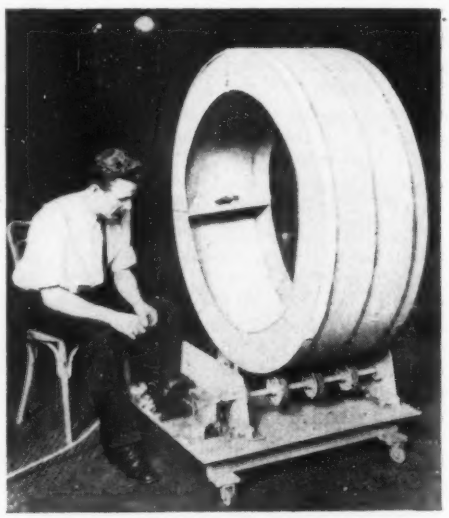
THE purchasing problem is one which is always with us. It is easy to obtain prices for comparison, but unless prices are coupled with some indication of quality they do not guide efficient buying. Recognizing this fact, some of the larger industrial companies, railroads, and the government bureaus, have established laboratories for determination of the quality of materials purchased. The general public up to this time has had to be satisfied with makers' or sellers' guarantees or representations and word-of-mouth endorsements from users, in addition to such judgment and experience as are available. This problem is very much in the foreground at the present time, as witnessed by such movements as that of the Federation of Women's Clubs, the Consumer's Research, Inc., the various "institutes" maintained by publications, and so on, which endeavor to supply a service in recommending to members or subscribers the various appliances, devices, and supplies which after inspection and test can be recommended as satisfactory for purchase.

There is an observable movement also on the part of manufacturers of some classes of goods, principally in the engineering fields, to grade their own products and to issue such products under labels which the manufacturer guarantees will be affixed only to materials of a certain specified quality; for example, in recent advertising of pineapple products, a page advertisement was devoted to pointing out to the public the marks upon the cans which denote the various grades supplied. Some of the lumber manufacturers are guaranteeing the qualities of the gradings of lumber which they identify by branding the grade upon each piece of lumber.

THE real difficulties in this situation are that first, testing is expensive; and second, that the expense of testing is justified only when the quantities at stake are large enough; for example, it would not pay the individual purchaser of an electric refrigerator to have tests made upon all the existing types for the purpose of discovering whether he is purchasing the most efficient device for home use. Such a procedure would cost tens of thousands of dollars while his expenditure for the refrigerator would perhaps be 500 dollars or less. But if the purchaser is buying many units, or if there are many purchasers who wish this information, then the testing can be combined so as to make it not only an economic possibility but a really profitable proposition.

Acting on this premise, the Association of Edison Illuminating Companies over 30 years ago pooled some of its testing problems, and Electrical Testing Laboratories is the outgrowth of this co-operative effort. The people behind the laboratories have been far-seeing and have equipped the institution so that at the present time it is an organization open to the public in general where testing equipment and experts are available for investigations of many diverse problems and the equipment provided is very extensive and complete.

It is true that the bulk of the tests and investigations carried on at the laboratories are electrical in character but many of these involve problems outside the electrical field which demand collateral investigations. For example, the investigations of the quality of power cable bring in the study of the composition and properties of lead, copper, paper, and insulating oils, all of which are the component parts. In addition these components must be subjected to mechanical tests for strength, effect of distortion, and so forth, and electrically, tests must be made to determine the conductivity of copper and the electrical strength of the insulation. Studies must also be made of the effect of heat and cold, the heating effect and consequent deteriorating effect of time, heavy current, and so on, so that it is



An electrically operated tumbling barrel ready to test the appliance plug on shelf

A straw hat maker wanted his hat tested to find the heat inside as compared with that within a felt hat

An abrasion machine for testing appliance cords is an example of machines designed to test to destruction

necessary to provide very large and expensive equipment and even more important, a staff of experts who can bring to bear on the testing problems a wide variety of experience.

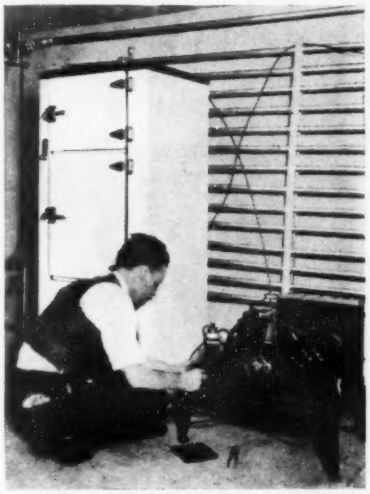
At the present time, these laboratories occupy several buildings situated at the corner of East End Avenue and 80th Street, New York City, comprising 66,000 square feet of floor area. There is a force of 325 people, 225 of whom are engaged in work at the main laboratories and 100 who are traveling or resident inspectors located at various factories from Boston, Massachusetts, to Oakland, California. Traveling inspectors visit practically every state.

THE magnitude of the work which is done can best be realized when it is explained that tests made by this laboratory in the past year covered the inspection and testing of over 300,000,000 incandescent lamps, 9,000,000 feet of power cable, over 1,000,000 porcelain enameled steel reflectors, design tests of all of the automobile headlamps in use in 20 of the eastern and central states, besides some 8000 miscellaneous tests for large purchasers, manufacturers, and consulting engineers covering many varieties of electrical apparatus, and appliances. Many thousands of electrical safety devices, such as rubber gloves, linemen's protectors, overshoes, leggings, insulated tools, and so forth, are regularly inspected and tested.

In the chemical department analyses have been made upon such diverse materials as steel, coal, paper, soaps, typewriter ribbons, pencils, insulating varnishes, oils, gasoline, boiler compounds, water, and fuel oils.

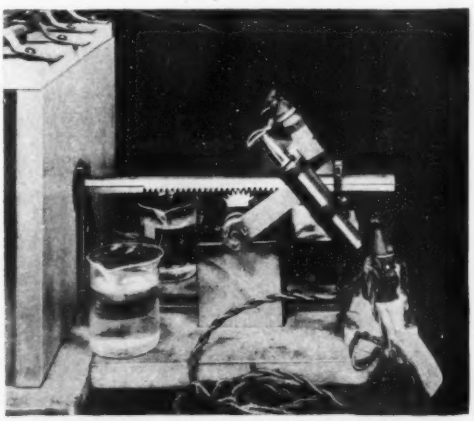
During the past year, a very interesting investigation has been carried on for the electric light and power companies which comprise the Association of Edison Illuminating Companies, on electrical appliances which are used in the homes served by these companies. Samples of all types of electric flatirons, simple and automatic, over 50 different models of electric ranges, 150 appliance plugs, 100 types of appliance cords, many percolators, electrical refrigerators, toasters, and so forth, are being tested, in many cases to destruction, to find out their serviceability, so that these power companies may be in a position to recommend to their customers appliances which give good efficient service for long periods with a minimum of repair and readjustment.

The photometric department performs many services. In addition to the measurement of incandescent lamps, it



Testing an electrical refrigerator unit in a specially equipped room

makes tests upon lighting fixtures, search-lights, flood-lights, and flash-lights. Tests are also made by this department on the illumination of artificially lighted premises such as offices, banks, railroad terminals, and lighted streets. It is sometimes called upon for tests of artificial and natural lighting, in connection with damage suits, both personal and as the result of restriction of natural lighting. Many tests of this kind are also made in connection with the determination of the validity of patent claims.

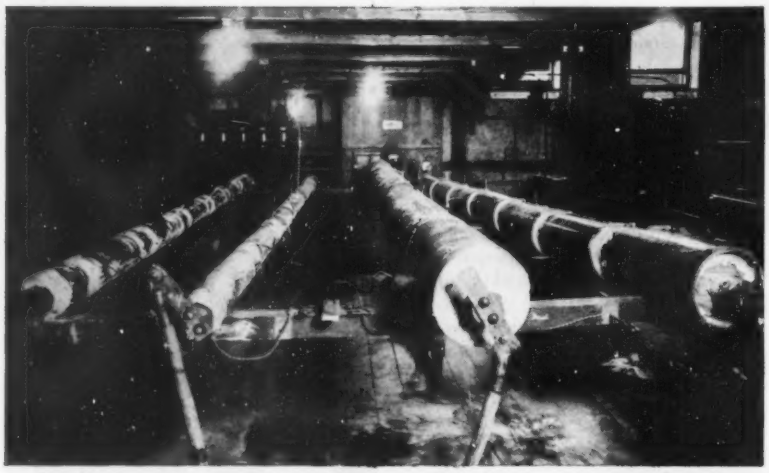


A machine that will substitute for a lot of shaves in determining the life of a safety razor

Perhaps the most interesting examples of testing are those which may be termed "freak" investigations. For example, a dead goldfish was submitted by a hotel in New York with a request that a determination be made of the amount of copper sulfate in the body of the fish, it being thought by the client that the fish was poisoned by the absorption of copper sulfate from a copper tank in which a large number of fish were kept in the hotel lobby. A manufacturer of cigarettes submitted a number of brands of cigarettes to determine the heat of burning the cigarettes under normal smoking conditions in order to prove an assumed superiority of one brand. Three brands of golf balls were tested for relative resiliency. Samples of procelain-enameled iron were submitted for tests of deterioration of the enameling under acids which might be encountered when metal table tops are subjected to ordinary kitchen usage. A manufacturer of straw hats submitted his product for test in order to find the relative heat inside the straw hat as compared to the heat inside of felt hats, the hats being exposed to direct sunlight.

Filling rubber gloves with water as part of an electrical leakage test

IN this category also may be placed the tests made for investors who wish to know something about the value of an invention or process in which they are considering investment of capital. For example, a gasoline substitute was submitted, which upon analysis was found to be composed of a fair grade of gasoline with a small admixture of lubricating oil to give it color. A rechargeable dry battery was found to be simply a good dry cell of a standard type with a new label substituted. A storage battery compound, warranted to increase the capacity of any lead-sulfuric acid storage cell, was found to be made of corn starch which had no beneficial effect. A new type of airplane cloth reinforced with very light but strong steel wires designed to add materially to the strength of the material was subjected to mechanical tests. A so-called "electric therapeutic" device, which it was alleged had effected marvelous cures of rheumatism and sci-



A view of part of the mechanical laboratory where tests for thermal conductivity, valuable to manufacturers, are being carried out on various steam-pipe coverings

atica, proved upon investigation to be a nickel-plated cylinder filled with sealing wax.

It is not only in exposing obvious frauds that these laboratories function. These constitute but a small though interesting fraction of the work of the laboratory. It functions often in connection with the development of processes which are brought to satisfactory and successful results. There may be cited in this class the Klaxon automobile horn which was designed by a client of the laboratories, working in a private shop and submitting from time to time the results of his labor for tests. Several manufacturers of insulating varnishes have used tests developed in the laboratories in connection with their own experiments in the blending of varnishes not only to increase the insulation resistance of their varnishes, but also to increase the length of time that the varnished cloth or paper made up with their compounds would remain pliant. A manufacturer of diffusing glassware, by continued experimentation, designed a form of translucent glass which transmits a considerably larger amount of the light falling upon it than was apparent in the first samples submitted.

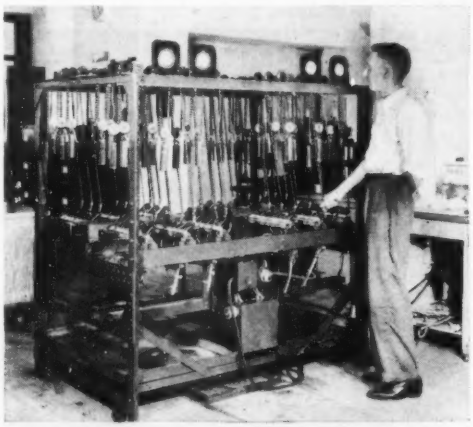
DURING the World War, manufacturers of star shells for lighting battlefields at night, by constant test and experimentation of various mixtures, increased the illuminating power of such shells from 10,000 candlepower with a burning period of 30 seconds to over 100,000 candlepower with a burning period of a minute and a half, eliminating also a great deal of the flicker which was characteristic in the first samples. In all these cases, the tests were made for the manufacturers upon samples which they fabricated using the formulas which had been suggested or proved by repeated tests.

After a cable has been tested on over-load, insulation is inspected

As was indicated previously, this institution is called upon from time to time for tests in connection with legal controversies. In such cases, the laboratory prefers to be retained if possible by both sides and to make the results of its tests available to both parties in the action. As examples of this type of service, there may be cited a test which was made to determine the electrical resistance of a pair of shoes which had been worn by a lineman who had been killed by an electric shock; the testing of a street lighting installation to determine the compliance to specifications of the street lighting equipment used by a power company; the measurement of natural light reaching the windows of a building; the measurement of the loss of light occasioned by changes in the construction of the Manhattan Elevated Railroad in New York as a basis for determining the compensation to be paid to owners of adjoining property. Very often in such cases the variation in natural lighting is so great as to make it impracticable to obtain complete measurements on the actual premises. In such cases, a few check measurements are made in actual position and a scale model is constructed which is artificially illuminated. An exhaustive study of the model is made, in this way eliminating all the variable features except those that are in question.

IT is to be expected that an organization of this kind is called upon from time to time to make tests for inventors whose hopes for success are greatly in excess of the merits of their inventions. In such cases, the attempt is made to dissuade them from spending money foolishly. In the 34 years of existence of this institution, there have been submitted perpetual motion machines, direct-current transformers, lighting appliances which are designed to multiply the total flux of the original lamp 100 times, electric generating machinery for producing more than 100 percent of the power put in, mechanical and electric water heaters of 200 to 300 percent efficiency. The problem in these cases, a diplomatic one, is to dissuade the inventor and at the same time to convince him that the laboratories are not the agent of the trusts which are engaged in keeping back improvements which might revolutionize industry and thereby destroy invested capital.

Many more instances of the variety and interest of the work might be given but the bare outline which is presented indicates the wide variety of effort which is characteristic of the testing problem, the diversity of the clientele which must be served, and the value of constant continuous research as an aid to betterment of conditions, the safeguarding of human life and property, and the encouragement of progress.

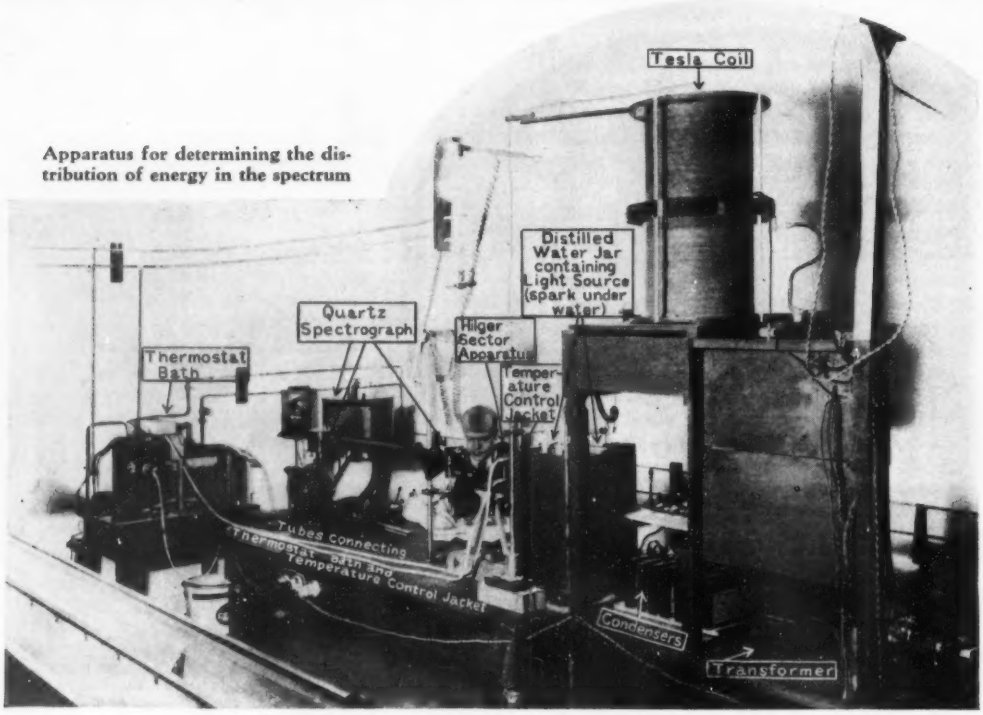


Electric appliance plugs get hard usage in service; this machine tests them more severely

Courtesy *Illustrated London News*

ARCHEOLOGY ENTERS THE STAMP WORLD

1. Egypt, Rock Temples of Abu Simbel. 2. Algeria, Ruins of Timgad. 3. Armenia, Sculpture at Ani. 4. Algeria, Ruins of Djemila. 5. Egypt, Pylon of Karnak. 6. Egypt, Pyramids. 7. Italy, Church. 8. Iraq, Cherub. 9. Italy, Monastery. 10. Egypt, Sphinx. 11. Armenia, Wall Sculpture at Ani. 12. Egypt, Colossi of Thebes. 13. Armenia, Ruins of Ani. 14. Palestine, Citadel, Jerusalem. 15. Iraq, Winged Bull, Ancient Babylon. 16. Syria, Ruins of Palmyra. 17. Iraq, Shia Mosque, Kadhimain. 18. Iraq, Sunni Mosque, Muadhdham. 19. Syria, Ruins of Palmyra. 20. Cyprus, Coin of Amathus. 21. Crete, Goddess Ariadne. 22. Iraq, Arch of Ctesiphon. 23. Crete, Hermes. 24. Cyprus, Mosque. 25. Italy, Capitol, Rome. 26. Greece, Acropolis. 27. Greece, Vase depicting Pallas Athene. 28. Greece, Temple of Theseus. 29. Greece, Acropolis with Parthenon. 30. Mexico, Pyramid of the Sun. 31. Lebanon Republic, Ruins at Baalbek. 32. Tonga, Haamonga. 33. Lebanon Republic, Ruins at Baalbek. 34. Guatemala, Monolith of Quirigua. 35. France, Pont du Gard. 36. Crete, Ruins of Minos Palace. 37. Mexico, Ancient Aztec Gateway. 38. Armenia, Ruins of Ani. 39. Italy, Aqueduct of Claudius.



Apparatus for determining the distribution of energy in the spectrum

WHAT IS A QUANTUM?

By PAUL R. HEYL, Ph.D.

Physicist United States Bureau of Standards
Author of "The New Frontier of Physics"
Contributing Editor *Scientific American*

"DO you remember," said the visitor, "when I came here some time ago, asking you to tell me what an atom was?"

"Yes," said the scientist, "and I could not do it."[1]

"Perhaps you did better than you thought. Now I have another question to ask you."

"I hope it is something easier this time."

"Well, it isn't about Einstein. I only want to know what the quantum theory is all about. What is a quantum, anyway?"

"You do not seem to be getting any more moderate in your demands," said the scientist. "How much do you know about it, to begin with?"

"Very little. All I have gathered is that a quantum has something to do with energy, and that it is considered a very important thing nowadays."

"Then so far you have nothing to unlearn," said the scientist. "We may as well start at the beginning. The quantum theory is a good illustration of the fact that history is prone to repeat itself as well in scientific thought as elsewhere."

"How is that?" asked the visitor. "Is not science always progressive?"

"Yes, certainly; but some parts of it progress faster than others, principally because they had an earlier start. Our ideas regarding energy, for example, have recently undergone a change similar to that suffered by our concept of matter a great many years ago."

"In what way?"

"MATTER has been studied by man for thousands of years. It was at first supposed to be continuous in its structure, as indeed it appears to be; but our present idea is that it is really discontinuous in its structure, built up of atoms and molecules and actually consisting principally of empty interspaces. This concept grew up gradually, but we may perhaps take the work of Dalton at the opening of the 19th Century as marking a time when the atomic theory was rather generally accepted."

"Yes," said the visitor. "I have heard him called the father of the atomic theory."

"Still," continued the scientist, "there were men of scientific standing all through the 19th Century who clung to the older continuous theory. The last great disbeliever in atoms, Ernst Mach, died as lately as 1916."

"You surprise me!" said the visitor. "I did not know that the past projected so far into the present."

"Such are the facts of the case," replied the scientist. "This last opponent of the atomic theory lived to see the doctrine against which he so hopelessly fought conquer not only the domain of matter but also that of energy."

"Are there then atoms of energy?"

"Something very like it; only we call them quanta. Energy is a comparatively new concept, dating back only to the middle of the 19th Century. When it first took shape it was regarded as continuous."

"Of course," said the visitor. "I have always understood it that way. The continuous stream of light and heat from the sun illustrates that."

"How do you know that the stream of light from the sun is continuous?"

[1] Heyl: *Scientific American*, July 1928.

"Why," said the visitor, "there are no dark spaces perceptible—but then," he added with a smile, "I suppose the same might be said of matter."

"Exactly. The cases are parallel. For good reasons we believe in the existence of atoms, though no one has ever seen them; and also for sufficient reasons we have come to recognize the discontinuous nature of energy. History is repeating itself in scientific thought."

"So that is what the quantum theory is all about!" said the visitor. "But how did this change in our ideas of energy come to pass?"

"Very much as the atomic theory of matter came to supersede the continuous theory. One was found to fit the facts of experiment better than the other. The historical parallel is perfect."

"This is getting interesting," said the visitor. "Tell me how it happened."

"IT began over 30 years ago, shortly after the discovery of the X rays. It was soon found that air or any other gas exposed to the passage of X rays became electrically conducting. Bring a charged electroscope near an X-ray tube in action, and the divergent gold leaves will collapse at once; the charge leaks away through the air, which under normal conditions is one of the best of insulators. It was found that this conducting property of the air was caused by the fact that some of its atoms were split up by the X rays into two parts, bearing opposite electrical charges, though the original atom was electrically neutral. This is called ionization of the gas. And the surprising thing was that so few of the atoms were ionized. Although the gas was swept through and through by successive waves of X rays, only about one atom in a million million was thus broken up."

"I should say," said the visitor, "that that net must have had a lot of big holes in it."

"Exactly," said the scientist, smiling. "Put into scientific language, that was just what J. J. Thomson thought about it. He was forced to the conclusion that the advancing wave of X rays was not uniform, but of a beady or lumpy structure, the energy of the wave being concentrated mostly in spots and spread out thinly elsewhere. His explanation was that only these intense spots of energy were equal to the task of splitting up an atom, and from the fact that so few atoms were ionized he reasoned that the wave front must be made up principally of thin places."

"A perfectly natural conclusion," said the visitor. "But where do the atoms of energy come in—and the empty spaces between them? This thick-and-thin structure is just as continuous as if it were uniform."

"True enough," answered the scientist. "The quantum theory carries things to the limit of *supposing* all the energy to be concentrated in the spots with the interspaces empty. This extreme the X-ray evidence that I have mentioned did not require, and it is a principle of scientific thought that we are never to assume more than is necessary to explain the facts. It required evidence of another sort to force us farther. This next step is due to Planck, who in 1900 suggested the modern form of the quantum theory."

"On X-ray evidence?"

"No; the evidence was of a different nature. It had to do with light. Theory and experiment had, in a certain field, failed to agree. Planck brought them into agreement by supposing energy to be atomic in its structure."

"Was the discrepancy between theory and experiment so serious as to require this radical step?"

"IT would have been serious, no matter what its magnitude, provided that it was great enough to be sure of; but judge for yourself. What happens when a piece of iron is heated?"

"It becomes red hot."

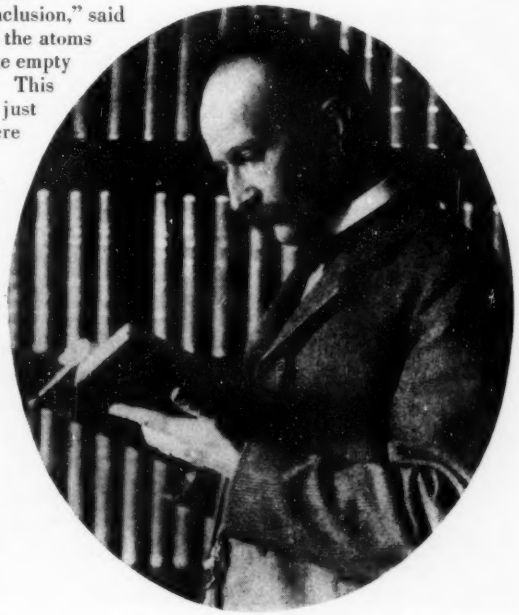
"And then—?"

"Yellow, and finally white hot."

"But suppose I should tell you that it should not act that way; that on theoretical grounds it ought to show a blue color from the start, no matter how hot it was?"[2]

"I should consider that a very serious discordance. Was it really as bad as that?"

"Yes, the classical theory insisted on predicting rays more intense than those actually observed, and of the wrong color. To take an analogy from sound, the emission of light from a gradually heated body is something like what happens when we press down and hold down all the keys of an organ in succession, beginning at the lowest. To the lowest frequencies would be added successively those higher in the scale, until at last the whole range (or spectrum) would be present. But the classical theory demanded that the high frequencies should appear from the start, and always be more intense than the lower ones."



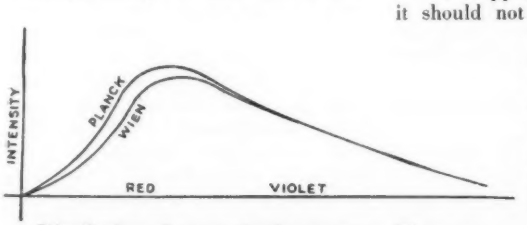
A rare photograph of Max Planck, who has been called the Dalton of the 20th Century. His law of radiation (1901) asserts that "radiant energy" is emitted and absorbed in integral multiples of indivisible quanta of energy. For his contributions to science he was awarded the Nobel Physics Prize in 1918

"And Planck's theory straightened out this discrepancy?"

"Perfectly. On the quantum theory we suppose that energy is made up of atoms or quanta. Less than one quantum can not be absorbed or emitted by a body, and all emission or absorption must be in multiples of this fundamental quantum."

The visitor looked blank.

"It is something like our money system," continued the scientist. "The smallest amount we can pay anybody is one cent, and any amount that changes hands must be a multiple of one cent. Now suppose your income was small, say one cent per hour, and that your creditors were pressing you. All you could do would be to pay out one cent now and then. This corresponds to the case of iron slightly heated. The influx of heat is not rapid, and the iron can emit only quanta of low frequencies—



Distribution of energy in the spectrum. The curve marked "Wien" represents the best that classical theory could do. The curve marked "Planck" is that given by the quantum theory, and fits much more closely the curve obtained by experimental work

[2] A. H. Compton: *Physical Review Supplement*, July 1929, page 74.

coins of low value. If your income was more rapid you might be able to pay out nickels or even dimes occasionally along with the cents. So as the iron is more intensely heated it is able to emit quanta of higher frequencies along with the lower ones."

"Is there only one fundamental quantum?"

"No, matters are more complicated than that. It is like having several different kinds of currency circulating together; English, French, German, as well as our own. The smallest coins of each kind would be different in value, and not exact multiples of each other; and we would have a series of multiples of each kind in circulation together. There may be many quanta of different frequencies, and a radiating body may emit multiples of any of them."

"But nothing but exact multiples? No fractional quantities?"

"Apparently not."

"Why is that?"

"We do not know."

THE visitor was silent for some moments. Then he said:

"The only reason why I can not pay out or receive anything but exact multiples of one cent is because the mint in this country does not coin anything else. It is not a limitation on my part. In England I would not find the slightest difficulty in paying out multiples of a half penny, although that is not exactly equal to one cent."

The scientist nodded approvingly.

"I agree with you. This curious restriction to multiples of a quantum in exchanges of energy may be a limitation arising from something in the structure of the molecule, or it may be that Nature's mint coins nothing but even multiples of a quantum. I am inclined to the latter view. The fact that a molecule can actually emit almost any quantity of energy that can be imagined, provided that there is a fundamental quantum of which it is a multiple, suggests that the limitation is not in the molecule."

The visitor smiled.

"I have read that Sir John Herschel once compared atoms to manufactured articles, because of their close similarity. Now it seems that we must think of energy likewise. Nature coins quanta and multiples of quanta, and it is against the law to clip or debase the coinage."

"Yes," said the scientist. "A quantum seems to be indivisible."

"Just as it used to be thought the atom was."

"Your point is well taken," answered the scientist. "But up to the present we have no experimental evidence requiring us to assume the contrary."

"Well," said the visitor, "to return to my original question, what is a quantum? If we magnified a light wave sufficiently what would we see?"

"It is no more possible to magnify a light wave sufficiently to perceive its structure than to magnify matter enough to see the molecules; but if we could sufficiently enlarge an advancing front of a light wave it would probably appear as a lot of bright specks on a dark background."

"That rather suggests Newton's corpuscular theory of light."

"Quite so, except for the important difference that each quantum is vibrating with a certain definite frequency."

"And what is it that vibrates? What is a quantum?"

"Nobody knows. Some have thought it to be a little train of waves, something like a dart; others have pointed out that it is more probably a three-dimensional affair. We have no more idea of what a quantum is than we have of the nature of an atom; and, as you know, our concept of an atom is a good deal like a moving picture."

"Three dimensional?" said the visitor. "How big is a quantum?"

"That question has been asked by others. The answer seems to depend on the direction by which we approach the question. For instance, a quantum of light must enter the eye as a whole to excite vision. Less than a quantum will not do. And yet, from astronomical considerations, a quantum of starlight must have about the dimensions of a barrel."

"And all that has to get into the pupil of the eye? That is something like packing the genie into a bottle."

"We frequently encounter contradictions of this sort in the early stages of scientific thinking about any subject. It indicates usually that our ideas are as yet incomplete and fragmentary. We must attain a broader and more general concept, of which these contradictory pictures may be seen to be special cases."

"The philosophers of old," remarked the visitor, "used to say that Nature makes no jumps; but what with atoms and quanta it begins to look as if discontinuity was the first law of Nature."

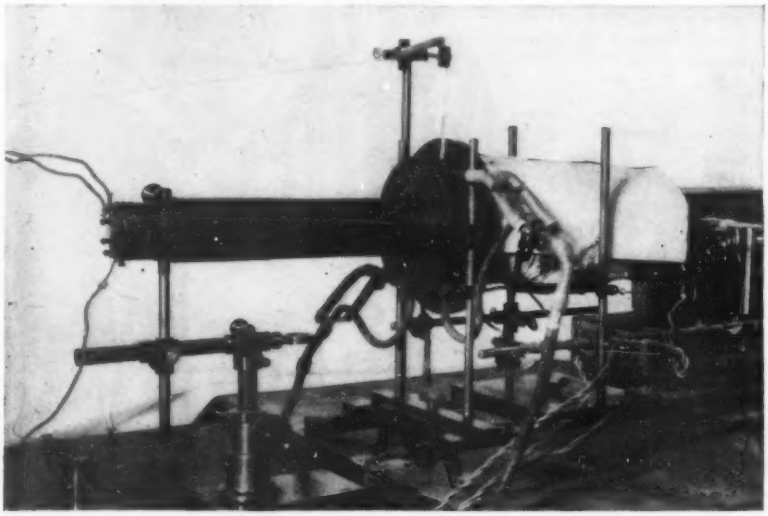
"There is a curious consequence of this discontinuity," said the scientist, "which probably you have not heard of. Suppose that you took a pocket full of pennies and went to visit an orphan asylum, and on your arrival found that there were more children than pennies. Even allowing only one cent to each child some would have to go without. But perhaps you see what I am coming to," said the scientist, breaking off as the visitor began to smile.

"Not exactly," said the visitor. "But I can see that for 'children' we must read 'molecules' and for 'pennies', 'quanta of energy.'"

"EXACTLY," said the scientist. "We have a pretty good idea of the energy value of a quantum just as we have of the size and mass of a molecule, though we can not tell just what either looks like. And it works out in this way: the total heat energy in a body may consist of fewer quanta than the number of its molecules. This is possibly the case in red hot iron. It is a curious thought that in such a body there may be molecules here and there as devoid of energy as if the whole body were at absolute zero."

"Poverty and riches rub elbows among molecules as with men," said the visitor. "Very human little fellows, these."

"Perhaps," said the scientist, "the molecules of which we are made up might view the matter oppositely, and with more reason."



Apparatus for determining the Stefan-Boltzman constant of radiation, which is connected with the distribution of radiant energy in the spectrum of hot bodies

FEEDING THE CREW OF A BATTLESHIP

By JOHN DONALD THOMPSON
Chief Boatswain, U. S. S. *West Virginia*

THERE are, no doubt, many hungry people within the broad domain of Uncle Sam, but if so, certainly they are not to be found upon his fighting ships. Food, selected and inspected, the finest in the world, is most plentiful. Carefully guarded, refrigerated, cooked hygienically and served under supervision from the cleanest of dishes fresh from electrically operated dish-washing machines filled with distilled water, boiling hot, the food reaches the men in its most tempting condition.

One hundred and ninety turkeys; more than 2000 pounds for only one meal! It sounds like a great deal, but it is only for a holiday, the fourth of July or Christmas, dinner to which must be added all the other good things that go with such feasts. The men, the boys that man the fighting ships are, most likely, far from home, but otherwise the holiday meal is just as tempting and complete. Then, to this must be added the novel surroundings of life on board ship and an appetite whetted by regularity, salt air, and wholesome exercise. On the fourth of July, at noon, 2000 pounds of turkey disappear from the plates of the eager boys as if by magic; the well rounded out menu is reproduced on this page.

I passed by the metal-screened door of the butcher shop where the head butcher was carefully explaining to a lady visitor (and as many other visitors as could crowd into the doorway) his daily labor in providing the meat portion of the daily ration for 1300 men.

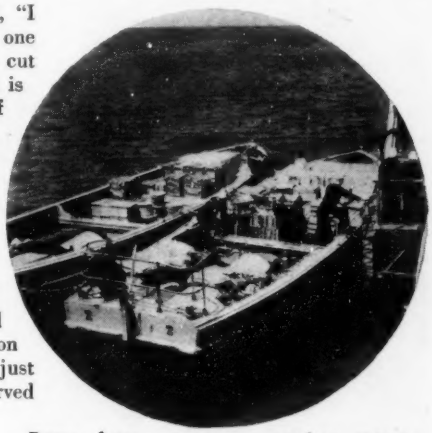
"Why," she exclaimed, "a ham will last us ever so long, even if we are all at home—and every one of us is a hearty eater!"

"Yes'm," he patiently explained, "I guess so, but 50 hams makes just one meal for us. It is boiled, then we cut it up and serve it out; none of it is ever left over. Lots of other stuff goes out from the issue room and the galley up forward. Beef? Oh yes, we use lots of beef. We cut up about 850 pounds of hind quarters into beef steak with this machine for one meal; then it is fried in the galley. Seven hundred and fifty pounds for veal cutlets and only 500 for stew. Six hundred pounds of halibut makes the noon meal on Friday; besides this, just about every sort of meat is served at various times."

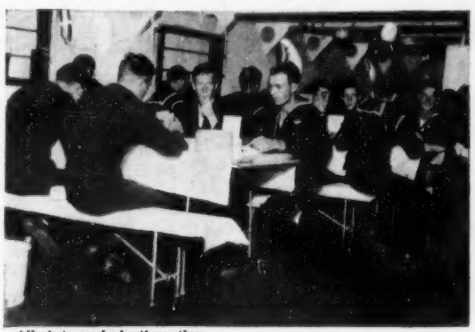
Lots of times when I pass the butcher shop I look in through the large round port hole; usually they are all busy cutting up meat or cleaning and polishing up the shop.

WE have thousands upon thousands of visitors from every state in the union, no matter what port we may happen to be in. Many men are detailed as guides to show them about the ship and make them feel at home. Sometimes I act as a guide myself, though not so often now, and it seems that all visitors, especially women, invariably ask to be shown, the "dining hall, the kitchen, and the pantry." So we take them down below and show them the great deck spaces hundreds of feet long and from 30 to 50 or more feet wide; this, they are told is the "dining hall," or more simply, the mess deck. From here, they are shown into the large galley that is lined with huge oil-burning steel ranges and steam-jacketed kettles manned by a dozen white-clad cooks busily preparing the next meal, the savory odors of which invariably bring forth exclamations of delight. This, they are informed, is the kitchen. They leave this attractive place of activity, of pleasing odors, with many a backward glance and exclamations of wonder.

"Now," confided one attractive young matron, "I must see the pantry. They may cook in a galley, but there must be a pantry." So the party was shown into the compact and abundantly stocked issue room with its snow white tiled deck and glistening shelves, its rows of



Boxes, bags, crates: two 59-foot motor launches at the gangway with provisions



All photographs by the author

INDEPENDENCE DAY

4th of July, 1930

•M•E•N•U•

Sweet Pickles	Green Onions
Queen Olives	Celery Hearts
Pineapple Salad	Sweet Mayonnaise
Cream of Celery Soup	French Croutons

Roast Imperial Turkey
Celery Stuffing Giblet Gravy
Creole Potatoes Buttered Squash Sweet Corn on Ear
Sunshine Cake, frosted Blackberry Pie
Neapolitan Ice Cream
Cigarettes
Coffee

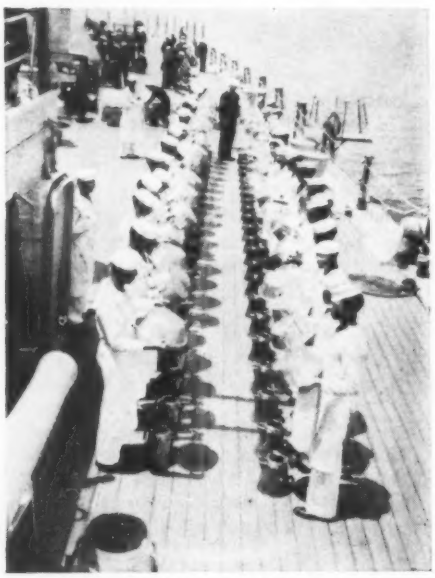
Any doubt that our sailors are well fed will be dissipated by one glance at the menu at the left and at the healthy, happy faces in the illustration above. During such a holiday meal, 2000 pounds of turkey disappear from the plates of the sailors

polished bins, barrels of pickles and vinegar, rows of sacks of sugar and beans, and the untold number of things that go to fill the pantry, or as we call it, the "issue room."

"And this," said the guide to the attractive young matron, "is the pantry."

After marching forward on one deck and aft on another without having seen anything resembling a dining table, the party is sure to ask where the tables are. They are then pointed out, neatly stowed in pairs on iron racks overhead between the beams. Each table is fitted with folding iron legs, as are the little benches that fold up and are stowed on top. When taken down and set up for use, they seat 10 men quite comfortably. One mess consists of 20 men using two tables and served by one mess cook, or a total of 21 men. The number of messes varies somewhat, but averages around 65.

The mess cook, who does no cooking at all, brings the food from the galley, the bake shop, and the issue room, and the dishes from the scullery. He also washes the knives and forks, besides cleaning up the deck and a considerable portion of the paint work in the immediate vicinity. Then once each week he has to take the tables up on deck and scrub them with sand and bleach them out in the sun.



On deck in bright sunlight, the daily inspection of shiny coffee pots and dish pans

If it so happens that a mess cook is good in bringing down "seconds" from the galley, the boys give him a lift now and then with the work and of course help in stowing the tables overhead. After a period of time, usually three months, the detail is relieved. Sometimes they stay for many months on this duty and seem to like it. When I was a mess cook, food was rather scarce and I was well pleased when I went back on deck.

The dishes are washed in a scullery where the far famed "scullery maid" would have found delight, for in their metal racks like eggs in a carton, the dishes for 1300 men are washed and stowed in from 14 to 19 minutes with an electrically operated dish washing machine having a crew of four men and one checker. After having been washed they are stacked, in their own racks, upon shelves, all ready for the next meal.

Visitors note with satisfaction the "spud coxswain" and his gang of a dozen or more men as they busily prepare vegetables in the vegetable-locker adjoining the galley. About one ton of spuds, or potatoes, are prepared each day. Two electrically driven peelers make quick work of about 20 sacks, then each one is gone over by hand for spots. If required, they are passed through the slicer for French fry, or go into the steam-jacketed kettles to make the well known mashed potatoes. Celery, lettuce, cabbage and, in fact, just about all vegetables are prepared only by the crate.

IN looking over the accounts I note that the boys have used in one half month, 10,000 pounds of cantaloupe besides 8000 pounds of watermelon and 1500 pounds of various berries. Eight hundred pounds of green onions must have been a lot of onions, but it went along with 10,000 pounds of green corn; 1500 of lettuce; 2000 of cabbage and a like amount of celery; 1400 of ripe tomatoes; and 1000 of bell peppers, and numerous other items that would appear small, being, as they are, under 1000 pounds. Fruit is served much more than is commonly believed —practically every day if possible. If fresh fruit is not available, the canned article is used.

In the preparation of vegetables, 20-gallon steep-tubs are used. In the cooking, either the 40- or the 60-gallon steam-jacketed kettles are used. The same kettles then come in handy when cooking macaroni, stew, beans, and numerous other standard articles of diet while the long row of steel, oil-burning ranges is principally used in the preparation of meat. One of the principal troubles encountered with meat is that it has to stand for some time after cooking before it is served; this has never tended to improve the quality of meat.

Having passed through the wide, white-tiled galley with its long rows of huge kettles and ranges, the visitor comes to the coffee pot. A shining copper urn of 120-gallon capacity, majestically it stands beside the galley door. Its eager daily visitors are legion, for be it known that "Jamoke" has ever played a most important rôle in the daily life, and it might be said, the night life, of both the old-time shellback as well as the sailors of the modern man-of-war.

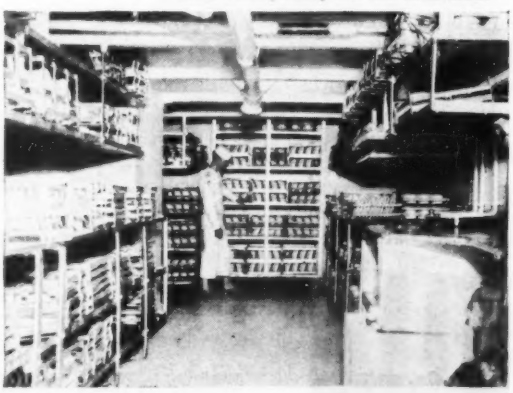
COFFEE is served out to the crew at 5:30 each morning; then once again for breakfast and at noon. Tea or cocoa is usually served with the evening meal, but coffee drinking is general throughout the ship both day and night, especially by the men on watch. The daily inspection of coffee pots is a pretty sight. The mess cooks are lined up in formation in spotless white uniforms with aprons, each with his shining coffee pot and bright dish pan.

Once outside the galley, the door of the bake shop stands invitingly open, while from within issue tempting odors of newly baked bread mingled with that of spiced pies and delicious pastries. Inside this Aladdin's shop, huge electric bake ovens silently perform their tasks while the electrically driven dough mixer vies in slow rhythm with the lively tune of the cake mixer.

Stacked in neat array against the steel bulk-head, ready at hand, you observe many tons of flour and sugar besides the ample stock of ingredients that go to make up the bread and pastry shop of the ultra-modern man-of-war.

For the time being the visitor is apt to think that the navy is simply a place ingeniously equipped for the preparation of food, for hardly has he passed out of this novel bakery when he is confronted with another galley entirely different from anything seen before. This time the roaring ranges are presided

The dishes are stowed in metal racks like eggs in a crate. After being washed, they are stacked, in their racks, ready for the next meal



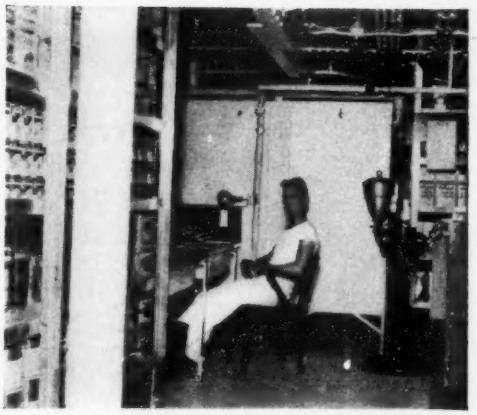
over by men of different races: Filipino cooks, Negro cooks, and sometimes a Japanese. This is the officers' galley where these mixed races deftly ply their art. From this galley, a sparkling gem of efficiency, go the very choicest foods in the world to the officers' mess.

When necessary to provision ship, usually once each month, a day is set aside for that purpose. About 100 tons of provisions, consisting of both fresh and dry stores about equally divided, are taken on board that day. About 50 tons are tinned and sacked stores while the rest is all of the fresh or perishable variety. The meats are frozen and go into the refrigerator while most of the fruits go into the chill room with the eggs, the butter, and the cheese.

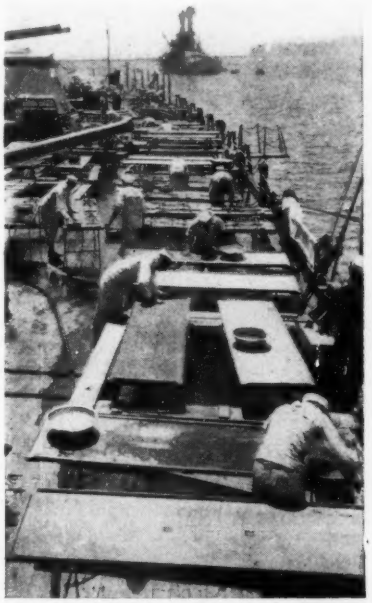
SOME of the articles loom rather large. Of beef there will be 20,000 pounds and of sugar a little more. Flour soars to 30,000 pounds while potatoes top the list and run between 40,000 and 50,000 pounds. Coffee keeps well above 1500 pounds; pork loins run about 4000 pounds while one ton and a half of hams skimp sadly by. Bologna and "franks" are slightly less and 1500 to 2000 pounds of chicken or turkey simply means one meal. Five thousand pounds of butter together with 3000 dozen eggs fried with 1500 pounds of bacon finishes a good many breakfasts to the fighters of the nation's first line of defense. Six thousand cans of milk are used each month in cooking and in coffee, while 600 pounds of yeast finds its way to the bake shop.

On one day each week a working party of some 25 men are engaged in bringing up provisions from the well-stocked store room to the commissary issue room. This issue room presents a most imposing appearance. It resembles a fully stocked grocery store minus any perishable articles except fruit and is presided over by a specialist in commissary work, who is a diplomat capable of keeping the crew contented and the captain satisfied—a task of no mean proportions. An army is said to travel on its stomach; a navy, then, might be said to sail on its stomach with the commissary steward as the chief pilot supported by his ample store rooms filled to capacity with practically every known article of food on the market, in the finest condition, ready to weather the storm.

Every week a bill of fare is made out for each meal that is to be served; in the case of holidays a blank is left and a special printed menu is made out. These bills of fare are posted in all branches of the commissary department. Then the cooks, bakers, butchers, and the men in the issue room can make all preparations to furnish all the items listed, and in the exact quantities required.



The Issue Room and the desk from which all orders of food are issued. The ship's pantry



The mess tables are scrubbed with sand and bleached in the sun on deck

The number of men to be fed each day varies; men are received and transferred; others go on leave or to the hospital, so that a definite number is never possible to count on for any great length of time. Yet there must be plenty of food without any additional allotment of money. Great care must be exercised or the ration, usually 50 cents per day, will not be sufficient. It is remarkable that such a bill of fare as that for the first three days of a week, reproduced in these columns, can be maintained at that price.

Imagine the great amount of fine detail work necessary to combine the numerous combinations of food in the large quantities required, in order that each man may sit down to his meals on the exact minute, three times each day during the year.

BILL OF FARE *for the* GENERAL MESS

Beginning June 30th, 1930

	BREAKFAST	DINNER	SUPPER
MONDAY	Cantaloupes, Corn-flakes, milk, sugar. Scrambled eggs, braised bacon. Lyonnaise potatoes. Vienna rolls. Bread, butter, coffee.	Vegetable soup. Crackers. Grilled beef steak, onion gravy. Mashed potatoes. Steamed peas. Shirred lettuce. Apricot pie. Bread and coffee.	American chop suey. Steamed rice. Boiled sweet potatoes. Tapioca-fruit-pudding. Bread, butter, tea.
TUESDAY	Cantaloupes. Boiled hominy grits, milk, sugar. Fried pork sausage, pan gravy. Creamed potatoes. Parkerhouse rolls. Bread, butter, coffee.	Cream of tomato soup. Saltines. Pot roast of beef, brown gravy. French fried potatoes. Boiled cabbage. Sliced tomatoes. Mincemeat pie. Bread and coffee.	Fried hamburger steaks. Worcester gravy. Boiled new potatoes. Macaroni-Italian. Beet-onion salad. Chocolate pudding. Bread, butter, tea.
WEDNESDAY	Oranges Baked pork and beans. Tomato catsup. Hot corn bread. Bread, butter, coffee.	Bean soup. Saltines. Fried pork chops. Country gravy. Mashed potatoes. Corn on cob. Boiled turnips. Shirred lettuce. Pumpkin pie. Bread and coffee.	Fried beef liver. Onion gravy. Boiled potatoes. Mashed summer squash. Green onions. Watermelon. Bread, butter, tea.

MORE ABOUT PLUTO

By HENRY NORRIS RUSSELL, Ph. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

EVER since the discovery of the new planet Pluto it has been eagerly observed at many places. More than a hundred accurate observations of its place in the heavens have been secured, and from these a rich harvest of knowledge has been reaped. The numerous observations of March, April, and May improved our knowledge of the orbit so much that, figuring backward, its position in past years could be calculated and images of the planet, in some cases very faint, were thus identified on photographs taken at Uccle, Belgium, in 1927, at Yerkes in 1927 and 1921, and at Mount Wilson in 1919. With these available the observed arc of the planet was multiplied twenty fold.

The calculations of Crommelin in England, and of Bower and Whipple in California, based on this fuller material, agree closely and leave no doubt outstanding about the main characteristics of this most interesting object. First and foremost the claim of the newcomer to rank as a planet is decisively confirmed. Though the eccentricity and inclination are greater than for any of the eight principal planets which were previously known, they would pass as moderate among the asteroids and there can be no hesitation in assigning the new body to the ninth place among the sun's more important attendants. There is nothing cometary about it at all; its orbit is far too near a circle and it is eight or ten times as far away as the distance at which even the brightest comets fade out into complete invisibility.

THE early calculations which indicated a highly eccentric orbit turn out to have been upset by a small error —only three seconds of arc—in one of the earliest photographic observations, made with a telescope of comparatively short focus and a long exposure. How such a small departure from exactness may be enormously magnified by the process of calculating an orbit was explained last month. In the second place the orbit, now that we know it, is found to be so similar to that which Lowell predicted from his calculations 15 years ago that it is quite incredible that the agreement can be due to accident. Setting prediction and fact side by side we have the following table of characteristics.

	Predicted	Actual
Period	282 years	249.17
Eccentricity	0.202	0.254
Longitude of perihelion	205°	212°30′
Perihelion passage	1991.2	1989.16
Inclination	about 10°	17°9′
Longitude of node	not predicted	109°22′

Lowell saw in advance that the perturbations of the latitudes of Uranus and Neptune (from which alone the position of the orbit plane of the unknown planet could be calculated) were too small to give a reliable result and contented himself with the prophecy that the inclination, like the eccentricity, would be considerable. For the other four independent elements of the orbit, which are those which Lowell actually undertook to determine by his calculations, the agreement is good in all cases, the greatest discrepancy being in the period, which is notoriously difficult to determine by computations of this sort. In view of Lowell's explicit statement that since the perturbations were small the resulting elements of the orbit could at best be rather rough approximations, the actual accordance is all that could be demanded by a severe critic.

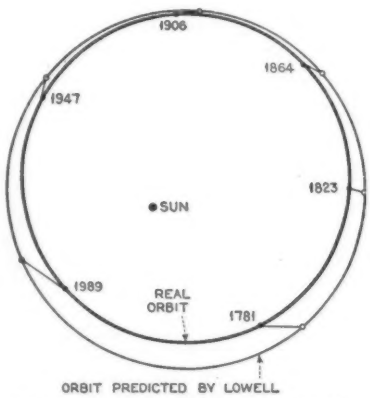


Figure 1: **Actual and predicted orbits**

Even so, the table does not tell the whole story. Figure 1 shows the actual and the predicted orbits, the real positions of the planet at intervals from 1781 to 1989, and the positions resulting from Lowell's calculations. It appears at once that the predicted positions of the orbit and of the planet upon it were nearest right during the 19th Century and the early part of the 20th, while at earlier and later dates the errors rapidly increased. Now this (speaking broadly) is just the interval covered by the observations from which the influence of the planet's attraction could be determined and, therefore, the interval in which calculation could find the position of the planet itself with the least uncertainty.

In the writer's judgment this test is conclusive. If someone should maintain that a calculation based on wholly insufficient data (and hence physically meaningless) might by some strange bit of luck result in predicting all four of the important elements of the orbit with the relatively small errors shown above, he would still have to account for the fact that the outstanding errors are so *adjusted* that their influences partly counteract one another and bring about the closest agreement of prediction and fact—just at the time when a genuine prediction, based on physically significant data, would have behaved in the same way!

IT may be remembered that substantially the same thing happened in the case of Neptune. Both Leverrier and Adams had assumed that the distance of the unknown planet agreed with Bode's "law," and had therefore taken it much too great. Their calculations made the orbit considerably eccentric (though it is really very nearly circular) but this spurious eccentricity brought the predicted orbit toward the sun in the region where the planet actually lay at the time, and went far to undo the error of two original assumptions. They still had the distance too great, however, and the predicted mass of Neptune was therefore considerably larger than the real value. There were some critics then who maintained that these discrepancies showed that the discovery of Neptune was only "a happy accident" but it has long been acknowledged that these critics were wrong, and the full credit for the great triumph of mathematical analysis has gone where it deserved to go.

History seems this time to have repeated itself closely, except in one tragic detail—Percival Lowell did not live

to see his prediction thus fully confirmed. In only one particular was he seriously wrong—he overestimated the apparent brightness of the planet more than ten fold. Several causes probably contributed to this. Pluto is somewhat nearer to Uranus and Neptune than he supposed, hence a small mass would suffice to produce the observed perturbations. Within a year or two—perhaps sooner—someone will doubtless make the necessary calculations and determine the mass of the actual, rather than the predicted, planet. We may guess that it will turn out to be four or five times the earth's mass, instead of six. Even so, it is evident that the planet must be of high density and its surface of surprisingly low reflecting power. But speculation on these matters may well be postponed until observations with the greatest telescopes, under the best conditions of seeing, which will undoubtedly be made this winter, tell us more about the planet's actual diameter.

THE relations between the orbits and motions of the new planet and those of Uranus and Neptune are curious enough to deserve mention. According to Bower and Whipple the mean distance of Pluto from the sun is 39.60 astronomical units (we may note in passing that this is close to the distance predicted by Bode's "law," 38.8, for the next planet beyond Uranus, but we will be wiser if we attempt no explanation). This puts the new planet, on the average, about 900,000,000 miles farther from the sun than Neptune. But the eccentricity is so great that the distance at aphelion is 49.7 and at perihelion 29.55—which is less than the perihelion distance of Neptune (29.82). If the two orbits were in the same plane they would intersect and there would be a chance of a collision. But the high inclination of Pluto's orbit keeps him well out of danger.

Figure 2 shows the orbits, Pluto's being projected on the plane of Neptune's orbit and a little foreshortened, which apparently brings its perihelion farther in. At the points where they appear to cross, Pluto is high above Neptune. The orbits are nearest at point A where the distance is 2.6 astronomical units (240,000,000 miles). This looks considerable, but when compared—as it should be—with the distance from the sun, it turns out to be by far the closest approach among any of the principal planets—when the two planets are nearest their distance from one another is only one twelfth of the average distance from the sun, while at the next closest approach between the earth and Venus this fraction is about three tenths.

Such close approaches are, however, very rare. The period of Neptune is 164.77 years, that of Pluto according to latest calculations is 249.17. (The computers, however, point out that on account of the observational errors this value "is determinate to about a year" and we must not draw conclusions from the last two figures.)

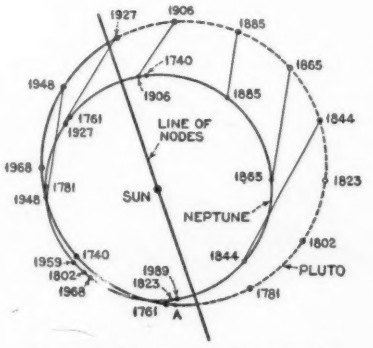


Figure 2: **Neptune's orbit coincides with the plane of the paper, that of Pluto being inclined 17° and intersecting that plane in the "line of nodes." The dotted part is below the paper, the full part above. Thus the orbits are not "grade crossings" and the danger of collision between the bodies vanishes**

Three revolutions of Neptune require 494.3 years. Two of Pluto take 498.3 years. The relative positions of the planets, therefore, almost repeat themselves at intervals of little less than 500 years. Just how they do it can be seen from Figure 2. The positions of Pluto are marked for 12 equidistant intervals, from one perihelion to the next, at intervals of 20.76 years, and also those of Neptune at the same dates. After eight intervals Neptune has completed a circuit of his orbit and advanced a little less than three degrees farther, which explains why the dots representing his positions are arranged in pairs. It appears from the figure that the two planets were nearest in 1892, and that

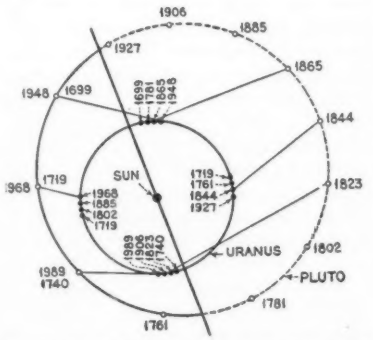


Figure 3: **Relative positions, 1699—1989**

at present Neptune is drawing more and more ahead of Pluto and increasing the distance between them. For more than two centuries the planets will get farther and farther apart, and it will be nearly 500 years before they are as close again as they were recently. "A stern chase is a long chase" and a simple calculation shows that, on the average, Neptune catches up with Pluto once in 486 years, during which interval one planet has made almost three revolutions and the other almost two.

At the recent conjunction, however, the distance of the two planets was 19 astronomical units—more than six times the minimum, and the perturbations, though greater than for centuries past or to come, must have been relatively small. When may we look for a really close conjunction?

A glance at the figure shows that Neptune passed the critical point of its orbit in 1824 and will do so again in 1989, while Pluto reached the corresponding point in 1763 and will do so again in 2012. On the latter occasion Pluto will still have 23 years to go when Neptune reaches the point of approach and, as Figure 2 shows, the planets will be a long way apart. Five centuries earlier Neptune came to the same spot in 1495 and Pluto in 1514, this time only 19 years behind. Working backward in this way we find the conjunctions closer and closer at each interval of five centuries, until in the year 976 B.C. the calculated times for the two planets agree within a few months. Still longer ago Neptune was behind Pluto and the conjunction less close.

IN the future, the successive "returns" of this conjunction will be less and less favorable but, working forward from 1824 when Pluto was 61 years ahead of Neptune and remembering that the former loses four years in every 494, we find that another close conjunction will occur about the year 9238 A.D. Still others will follow at intervals of about 10,200 years.

These figures, however, are liable to alteration if the true period of Pluto turns out to differ somewhat from that here assumed. If, for example, it were one year longer Pluto would fall behind by six years instead of four in three revolutions of Neptune and the dates of close conjunction would be 11 A.D. and 6765 A.D.; while if Pluto's period should be one year shorter the dates would be near 4000 B.C. and 17,000 A.D. and the interval between close conjunctions fully 20,000 years.

In any case it is clear that no conjunctions of the sort will occur until the span of recorded human history is doubled.

When they do happen the planets are close together for half a century or more, as appears again from a study of the figure. Though the orbital velocity of Pluto is on the average considerably less than that of Neptune, it increases so much at perihelion that for a short time the planet of longer period is actually moving faster and the two bodies

(Please turn to page 487)

Completed derrick on one of the two permits, built as described in the text. The landing wharf, with the steamer *Mahukona* and the tender *Daisy Freeman* in the distance. The derrick barge and the tug *Elwood* may also be seen

OIL FROM BELOW THE OCEAN FLOOR

By C. L. ROBERTS

OIL has been found in burning deserts, waste hills, fever-ridden jungles, cultivated lands where derricks supplant orange groves, and in the frozen steppes of the northland. Under the most favorable conditions drilling for oil is fraught with many difficulties and uncertainties. Consider, then, the problem of sinking a well beneath the ocean bed far from shore; the drilling being attended by legal and physical difficulties which at first glance would appear insurmountable.

The conditions surrounding this latest achievement of oil engineering were tersely described to the contractors, Robinson-Roberts Company of Los Angeles, by the owners of the permit to drill:

"You are to build the foundations for an oil derrick in the Pacific Ocean off shore from the Elwood field, in Santa Barbara County, California. Construction must take care of several things, chiefly prevention of pollution of the ocean by mud, oil, or other waste material; and provision must be made for controlling heavy gas pressure.

"The beach bordering our lease is backed by precipitous cliffs 200 feet or more in height and is so narrow that it is completely submerged at high tide. All shore land above the high-tide line is controlled by our opposition who are patrolling it with armed guards with orders to arrest trespassers.

"Last, but not least, you have just three months to complete the contract and 'spud in' the well or we will lose our permit."

Investigation disclosed that under a recent California law, drilling permits were being granted on state-controlled tide lands along the coast line. Preference was given to littoral owners but through a slip of some sort the permit in this instance had been given to a company that did not have shore lands and wells in this vicinity. The littoral owners sought to block the permitees and keep them from drilling within the time limit specified, hoping thus to compel the permit to lapse, when they would be in a position to apply for a new drilling right themselves.

THE prize at stake was an untold amount of high gravity oil, the type of crude which is the life blood of the industry. It has a high gasoline content and its discovery always is followed by a stampede.

Faced with this problem the contractors were required to pioneer, using methods of construction never tried before, and meeting conditions, the effect of which could not be foretold. Illustrative of this was the first question presented—that of wharf construction leading from the beach to the site of the derrick foundations. It was discovered that the ocean floor was a shale bed with no sand covering. This eliminated the possibility of using round wooden piling, but something had to be found that could be driven into this foundation and still have the structural qualities of the wooden piling.

Decision fell on steel, and what is known as the "H" column was selected. This type of piling has since been found to have the double virtue of being able to penetrate the shale and to resist by sheer weight the flotation action of the ocean.

The anchoring of the derrick, which on land is done with guy wires, was the next problem. It was solved by designing a foundation consisting of five concrete-filled cofferdams. Four of these were placed at the corners of a square and upon these the legs of the derrick were to rest. The fifth, larger than the others, was in the center and was to support the drilling machinery. Here also the question of pollution was disposed of. Under the permit any fouling of the ocean waters meant the loss of drilling rights. This central cofferdam was hollowed out and a steel diaphragm connecting with the four foundations was so constructed

that it sloped toward the center, thus catching oil drippings from the machinery, mud from the well, and things of like nature.

However, the two greatest problems were yet to be solved. The first meant working out new methods of construction where all contact with shore was cut off; and the second, obtaining an adequate supply of water for machinery and men.

Purchase of the steamer *Mahukona*, a wartime vessel, and her outfitting to carry supplies enough for the job and to house the workers, was decided upon as the answer to the first of these questions. On June 5 the steamer was placed in drydock in San Francisco and 10 days later she dropped anchor off Elwood. In the meantime she had been converted into a floating hotel and warehouse. Every available space was utilized, and a boat with quarters for a normal crew of 25 now housed 150 men, while every article necessary to the construction of wharf and derrick was stored aboard.

A WORD as to life on that ship will be apropos here, as it is indicative of the difficulties encountered. Anchored within sight of shore, its passengers were unable to set foot on land for diversion or entertainment. Every man was keyed up to high tension, working against time in the effort to complete the contract successfully. Three shifts of men ate, slept, and took their leisure hours in this restricted area so that one man's breakfast was another's lunch and the third's dinner. Men were sleeping, lounging about, or working, according to their employment hours. Beds were made and slept in, only to be remade immediately to make way for the next crew of sleepers. Meals were prepared in a galley eight feet by eight feet and the stove never got cold, for as soon as one meal had been served, the cook began preparation of the next.

With anchorage moorings prepared for the steamer, a derrick barge, two lighters, and two small launches, the actual work of attacking the first construction began. It was determined to build a small wharf on the beach to keep the machinery above high water. A load of short steel piles was sent ashore, through the surf in a skiff. Then the fun began, for it was some time before it was found that, to row a boat ashore through the breakers, we had to turn around and back her in. To this maneuver, sea authorities do not agree, even such a one as Richard H. Dana in his "Two Years Before the Mast," but it proved correct for us. It took several upsets before the lesson was learned but after that we always kept the bow seaward and thus escaped wettings.

THE short steel beams were placed upright in the sand by hand and a platform rigged on these posts. A water tank was floated ashore and rolled up on the small wharf. Then the barge came in with water tanks aboard and a man was sent through the surf with a hose-line, and a supply of fresh water was pumped into the big tank. Oil drums were floated in, salvaged on the beach, and rolled up onto the platform. Next a Caterpillar tractor, equipped with a winch, was sent along the beach at low tide, walked onto the wharf, and the shore start had been made.

The pile driver on falsework in the surf after it was landed from the beached barge, ready to begin work

It was necessary to get a pile driver on shore to begin constructing the permanent pier. A driver had been built on one of the barges by use of the derrick-barge and ships' gear. It was found that low tides occurred at night and highwater at noon. The plan was to beach this barge at high tide, and float it again at some subsequent high tide. Such a procedure would be risky due to the nature of the ocean bed which was cut up with finlike reefs. To strike one of these would mean days of costly delay.

Beaching the barge which carried the pile driver. Her hoisting engine pulled her in

An anchor was run ashore and sunk in the beach. This was attached to the bow of the barge to hold her on her course, while port and starboard anchors, which had been placed a short distance from shore, were attached to her stern, their lines run to the drums of the driver's hoisting engine. A stern anchor held the aft end in line. With the engine started, the forward line was taken in and the aft lines paid out, thus hauling the barge onto the beach through the surf.

Once grounded, all lines were made fast. Then a wire cable was attached to the driver and run to the winch of the tractor. The tautness of this cable minimized the surging back and forth in the surf.

WITH carbide flares providing light for night work, with no rest for the men, and with every available hand on the job, a race began to get sufficient piling driven so that the driver could be pulled clear of the barge before the next high tide. Men worked in water to their waists. Any tools that were dropped were left as there was no such thing as groping about in the sea to recover lost articles. Hours of high speed work passed with no thought of rest, but the next high tide saw the pile-driver pulled clear and the barge re-floated. The first real battle had been won.

The abnormally high tide that had favored work with the barge and driver, brought disaster to the temporary wharf, which collapsed, throwing the fresh-water tank into the sea. The water was so polluted with salt that it could not be used in the boilers and thus the problem of fresh water became acute.

Water consumption for men, ship,

and job was about 25 tons a day. The capacity of the *Mahukona* was 500 tons, of which 375 were in the "wing tanks," triangular in shape and running fore and aft along both sides of the vessel. Unless the ship were heavily loaded, these could not be filled, or the boat would capsize. The nearest water supply was at San Pedro, 125 miles away with a cost of 300 dollars for a tow from that port. In addition the only water-barge available had a capacity of 90 tons which meant a towing expenditure every third or fourth day. The solution came with the chartering of the steamer *Daisy Freeman* which was used as a water carrier and for lumber storage.

ALL did not run smoothly on the job. What with water, tides, fog, crowded quarters, foaming boilers, and loss of carbide flares and tools overboard, there were plenty of problems that had to be met as they came up. The gasoline launch began slipping its clutch owing to the propeller being fouled in the kelp. A tug was chartered to replace it. This boat was caught in a surge, its tailshaft was twisted off, and it went ashore. The barge used to beach the first driver, and later used for a second driver which began work on another permit covered by the drilling operations, got adrift and struck a reef. Here was a tug ashore and a barge hung up on a reef. Troubles never came singly but seemed to pile up all at once.

The tug was pulled off but this left us with men ashore and no means of conveyance to the mother ship. A fishing boat, skippered by an Italian who could not understand English, was hired, thus affording temporary relief, but the menace of the barge remained.

Far out beyond low tide level—one of the completed oil derricks

Derelicts have a way of wandering at inopportune times and there was the danger that the barge would suddenly float and go crashing through the falsework, which would be such a serious setback in time that the contract would be lost. And float it did, at 3 o'clock one morning. Luckily, it cleared the workings and was blown up by dynamite to prevent it from endangering our construction work further.

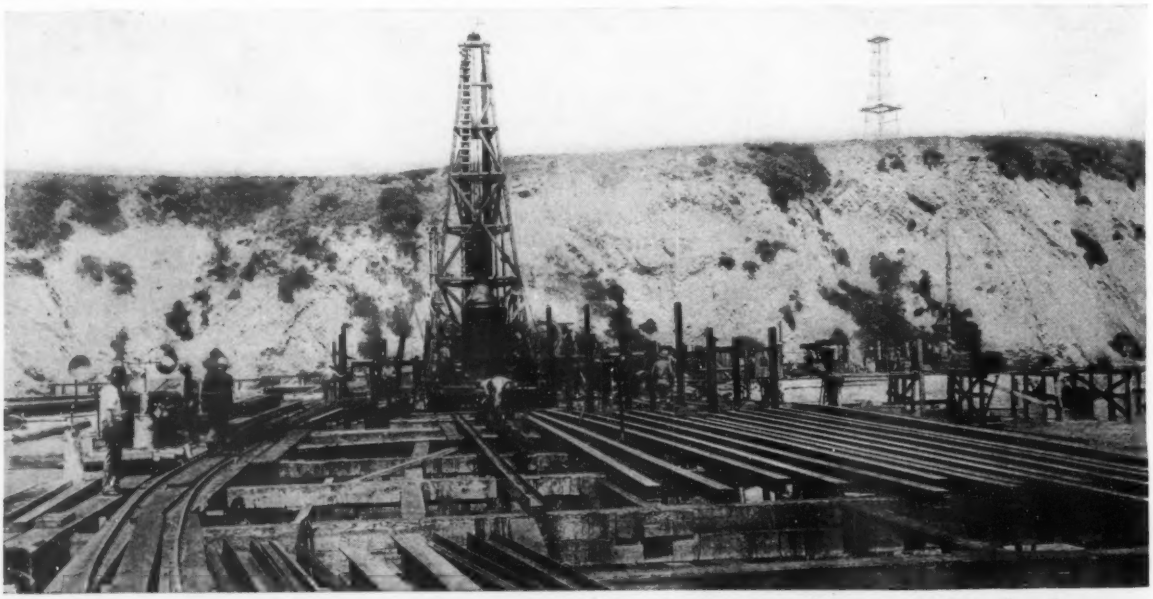
With work well started on the second permit, both jobs swung along at a good clip. Most of the material used was floated ashore and for over a month there was not a man on the job who was not wet from head to foot every hour of the working day. The genial steward, asking one of the men if there was anything dry on him, received the laconic answer: "Yeah, my hat." Yet, despite such handicaps, we progressed.

WITH the falsework driven seaward to the end of the dock, the pile driver headed ashore and took up the work of driving steel piling. The derrick barge was brought into play, being anchored in the surf. Her 100-foot boom swung load after load from the barge to the wharf and despite the lifting of the surf, which increased the arc of the boom, only one sling-load was lost overboard.

By this time divers were employed to retrieve tools and materials that might fall from the wharf or from the cofferdams where the work of erecting the steel derrick was under way.

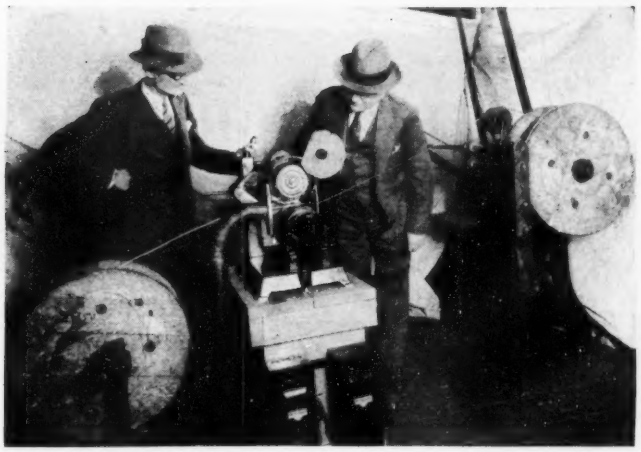
It was on August 10, less than two months from the time the *Mahukona* had set sail from San Francisco, that the first dock was ready, derrick erected and everything prepared for the spudding in. The second dock was completed 10 days later. The labor and effort this cost and the trying conditions under which it was accomplished beggar description. The joint cost was approximately 400,000 dollars.

Achievement brought a two-fold satisfaction. Pioneering methods in oil drilling had proved successful, obstacles that seemed insurmountable had been overcome, and oil in good flow was struck without further trouble.



One of the steel wharves under construction. Heavy steel and timber work were necessary. This view shows the character of the cliffs above the work and a producing well on the mesa above the beach. The pile driver is driving the "H" beams

Reclaiming used files by the steam sand-blast method. Approximately 15,000 files a month are reclaimed at the East Pittsburgh plant alone



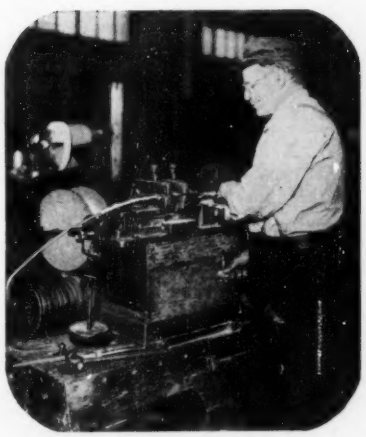
Above: A cable skinning machine removing the covering from a copper cable so that the metal can be used over again. Formerly, damaged wire became worthless scrap

The portable exhibit is shown all over the plants and is one of many such presentations carried around on trucks

Feet can be welded on discarded calcium carbide containers and so make perfectly good waste cans for the shops. Why buy new waste cans?

Used carbon paper can be rejuvenated three or four times by passing over an electrically heated cylinder. The saving is worth while

Right: Short ends of material make a real waste problem. This electrical butt-welding set makes "big ones out of little ones." The scrap pile is cut down still more



FACTORY WASTES TURNED TO PROFITS

INDUSTRIALISTS have long been worried by two problems which are always present. One is safety and the other is waste. Some of the factory wastes are unavoidable, but there are others that a little care will prevent, particularly with commonplace items which are often overlooked on account of their apparent insignificance. Competition, especially in the form of foreign made goods produced by cheap labor, is steadily becoming keener and if we want to hold our premier position by producing, as we have done in the past, at costs that will allow us to compete, we must eliminate the demon waste. Manufacturers are co-operating with the great engineering societies to bring this home to the employees by posters, actual examples of waste, and by a clever system of rewards for suggestions. The results of the campaign for waste prevention are far-reaching. The Oakland Motor Car Company saved 542,000 dollars in about a year as a result of suggestions. We illustrate some of the things done at the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

SCATTERED LIGHT AND THE RAMAN EFFECT

By R. W. WOOD, LL.D.
Foreign Member of the Royal Society
Professor of Experimental Physics at Johns Hopkins University
Contributing Editor, *Scientific American*

IF we are sitting in a darkened room and a beam of sunlight filters in through a chink in the shutters, it is a matter of common observation that the beam is itself invisible from the side, unless there is smoke or fine dust particles in the air. But when a whistle blast enters a room through a hole in the wall, the waves spread out, filling the entire room uniformly, and the ear hears the sound in one place as well as in another. We may explain this action of sound by considering the vibrating air, in the aperture in the wall, as itself a source of sound, which sends out waves uniformly in all directions.

This difference in the behavior of light and sound we express by saying that light is propagated rectilinearly or in straight lines, while sound is not, and it was precisely this difference in behavior that was raised as an objection to the wave theory of light when it was first stated in definite form by Huygens in 1678. The difficulty was cleared up by Fresnel who proved mathematically that, in the case of the extremely short waves of light, rectilinear propagation and the formation of shadows were due to interference. In other words we may consider that secondary waves of light start out laterally from every point on the beam of sunlight, just as we considered the sound as radiating from the aperture, but if we calculate their combined effects at any point outside of the beam, the resultant is zero, or complete darkness.

WE need not go into the proof of this, but it can be shown mathematically that, at all points within the shadow, radiations from any point in the illuminated region are destroyed by other radiations from some other point, the two sets of disturbances arriving half a wavelength apart and destroying each other. This is known as the Fresnel-Huygens principle.

Very high pitched sounds behave somewhat like light, evidence of "shadows" frequently being observed, while in the case of the very high frequency waves from vibrating quartz plates, such as were employed by Langevin for submarine signaling (see article "Sounds that Burn," SCIENTIFIC AMERICAN, March 1928) the "sound" can be projected through the water to a great distance, like the beam of a search light. Here the Fresnel-Huygens principle operates to destroy the spread in lateral directions. If any material particles, such as minute specks of dust, are suspended in the air traversed by the beam of light, each particle scatters light into

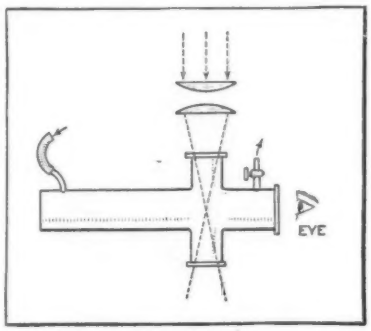


Figure 1

the shadow, and if very small indeed, the particles scatter blue light more powerfully than red or yellow. In other words the light diverted into the region of shadow is rich in radiation at the short wavelength end of the spectrum. The selective scattering of blue light can be seen by holding a lighted cigarette or cigar in a beam of sunlight, and viewing the smoke against a dark background. In general there will be several filaments of smoke rising, some white, in which the particles are comparatively large, and some blue in which they are smaller.

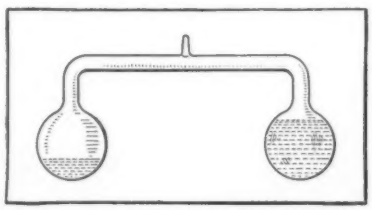


Figure 2

The blue color of the sky was formerly thought to be due to a similar scattering of light by very small dust particles suspended in the air of the upper atmosphere, but Lord Rayleigh's calculations indicated that the scattering in this case was due to the actual molecules of air. Many years elapsed before this scattering of light by pure dust-free gases was detected in the laboratory by Lord Rayleigh's son (the present Lord Rayleigh) and independently and at about the same time by Cabannes, a French physicist. Sunlight was focused by a lens at the center of a black tube, through a window in the wall, and a very blue cone of luminosity was observed through a glass window in the end of the tube, which was filled with air filtered through cotton-wool to remove dust particles (Figure 1).

SIMILAR results were obtained with other pure gases, even with hydrogen, the scattering power of which was many times less than that of air, while that of ether vapor was much greater. Some experiments were made by the writer at East Hampton, New York, with a view of comparing the intensity of the light of the blue sky with the intensity scattered in the laboratory by dust-free air. Sunlight was concentrated by a "reading-glass" lens six inches in diameter, at the center of a black tube, similar to that of Lord Rayleigh, and the blue cone seen in the tube was matched against a bit of blue sky reflected in a small mirror of black glass, which reflects 4 percent, through a very narrow slit in the rim of a large disk of black cardboard, rotating at high velocity in a dark room. In this way the intensity of the sky light was reduced to that shown in the tube. The total amount of air directly above us is the equivalent of an ocean of air of uniform density at atmospheric pressure five miles deep. This thickness of air, illuminated by normal sunlight, forms the blue sky. In the laboratory the layer illuminated was less than one eighth of an inch in thickness but the illumination at the focus of the lens was about 1400 times that of normal sunlight. The two could be matched by making the slit in the disk sufficiently narrow, and calculations showed that the blue sky could be fully accounted for by molecular scattering of light by the air.

A similar scattering was observed in pure distilled water, freed from suspended motes by repeated distillation *in vacuo* without ebulition in a double bulb, as shown in Figure 2. The bulb containing the liquid should be heated

to only 15 or 20 degrees above room temperature, or one bulb may be immersed in ice and the other kept at room temperature. After about one quarter of the liquid has passed over, this is shaken about in the bulb and then poured back into the other bulb, carrying with it any motes which may have adhered to the walls. After two or three repetitions of this process, nearly the whole of the liquid is distilled over, and it will now be found to be "optically clean"; that is, it will show no bright specks when sunlight is focused at the center, but only the pale blue cone of light scattered by the water molecules. It must be viewed against a black background.

NOW a very striking thing is shown in the case of scattering by a liquid and its vapor. We might very reasonably expect the scattering of the light to be proportional to the number of molecules present, and as there are roughly 1000 times as many molecules in a given volume of liquid as in an equal volume of its vapor at atmospheric pressure, we might look for an intensity 1000 times as great in the liquid as in the vapor. As a matter of fact we observe an intensity less than 50 times that of the vapor.

This is, however, precisely in accord with the theory, for in the liquid we have a nearer approach to a continuous medium and if the medium were perfectly continuous and structureless there could be no scattering, for in this case the secondary waves would destroy each other, just as they do when no material medium at all is present and they originate in the vibrating "ether," the hypothetical "medium," the vibrations of which constitute light.

This means that, in the case of the liquid, "interference" is taking place between the scattered radiations, and the lateral diffusion of light by the molecules is partially prevented. Transparent crystals, such as quartz, scatter still less light since the molecules are arranged in a perfectly regular manner on a so-called "lattice," and this condition approaches the condition of a continuous medium from a mathematical standpoint; at all events there are no variations in density from point to point such as occur in a liquid as a result of thermic agitation or the to-and-fro oscillation of the molecules which constitutes heat.

The absence of scattering in the case of a crystal lattice can be beautifully shown with a thin flake of mica. Both surfaces should be freshly cleaved, which can be most easily accomplished by rubbing the edge of a thin plate with the side of a needle until it is flattened, and then inserting the point between the layers of the mica. If a flake prepared in this way is attached to the edge of a carefully cleaned cover-glass, such as is used for microscope slides, the strong scattering of the glass, as contrasted with the absence of scattering by the mica, can be shown by focusing sunlight first on one plate and then on the other, viewing them against a dark background. It was formerly supposed that no change of color was produced by the scattering; or, speaking more accurately, no change of wavelength in the case of the blue smoke or blue sky. There is an apparent change of color, to be sure, but the scattered blue light was originally present in the white light, and the color is not produced by a change in the length of the light waves.

In 1923 Smeckal predicted from the modern quantum theory of light that if a medium was powerfully illuminated with monochromatic light—that is, light of a single wavelength, analogous to a pure musical tone—there should be present in the scattered light, faint traces of other monochromatic radiations and that a "spectrum" would be characteristic of the substance illuminated.

FIVE years elapsed before this prediction was verified by Sir C. V. Raman, the distinguished Indian physicist of the University of Calcutta; and at very nearly the same time by Landsberg and Mandelstamm, the former working with various liquids, and the latter with crystalline quartz.

The arrangement used by Raman is shown in Figure 3. The light from a horizontal mercury arc-lamp (through a draftsman's error, a carbon arc is shown) was focused at the center of a spherical flask filled with benzene or any other liquid, and the spectroscope pointed at the illuminated region at the focus. Exposures of many hours were necessary to secure a photograph of the spectrum, owing to the faintness of the light. Numerous bright lines were found in the case of every liquid examined. In the majority of cases the new lines were of longer wavelength than that of the exciting light—that is, they were on the red side of the spectrum lines of the mercury arc, but in the case of some liquids, such as carbon tetrachloride and chloroform, lines of shorter wavelength were found on the violet side of the same lines.

At first sight it might appear as if this was merely a case of fluorescence, but Raman found a remarkable relation between the wavelengths of the new

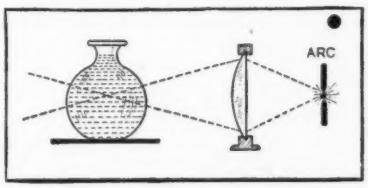


Figure 3

lines and that of the exciting radiation, which is quite different from anything observed in the case of the phenomenon of fluorescence.

In the first place he found that the arrangement of the spectrum lines in the groups excited by the various mercury radiations was exactly similar. For example, carbon tetrachloride gives a spectrum shown by diagram in Figure 4, the two mercury lines being indicated by arrows. The lines to the left of the mercury lines are of shorter wavelength than that of the exciting line and are called "anti-Stokes lines," being exceptions to a supposed law formulated by Sir George Stokes, that, in the case of fluorescence, only radiations of wavelength longer than that of the exciting light could be emitted. The relative spacing is the same to the right and left of the exciting mercury line except that it is reversed. Secondly, he found a very remarkable relation between these new lines and the absorption bands of the substances in the remote infra-red region of the spectrum. If the frequencies of vibration of the Raman lines are subtracted from the frequency of the exciting light the numbers obtained represent the frequencies of the infra-red absorption bands which are found experimentally only with considerable difficulty.

WE thus have a very simple and direct method of investigating the infra-red absorption of substances by means of visible light, and of securing data on the structure of complex molecules. The matter has turned out to be somewhat more complicated than was at first supposed, for not all Raman lines have infra-red absorption bands associated with them, and some infra-red bands are not represented by Raman lines, but the theory is being gradually worked out.

The original and simpler theory, as first given by Raman, explaining the formation of anti-Stokes lines, is as follows: The quantum theory of light regards a beam of monochromatic light, say the green light of the mercury arc,

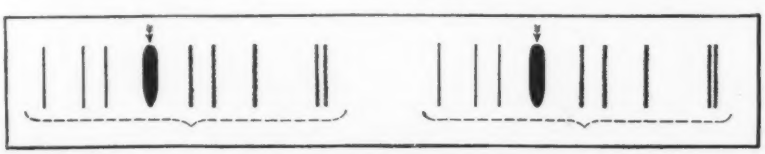


Figure 4

as made up of discreet "packets" of energy, all of the same magnitude, called "light quanta." As the beam diverges in space these quanta merely get farther apart, without suffering any loss of energy. The energy content of a light quantum increases progressively as we pass from the red to the violet and ultra-violet.

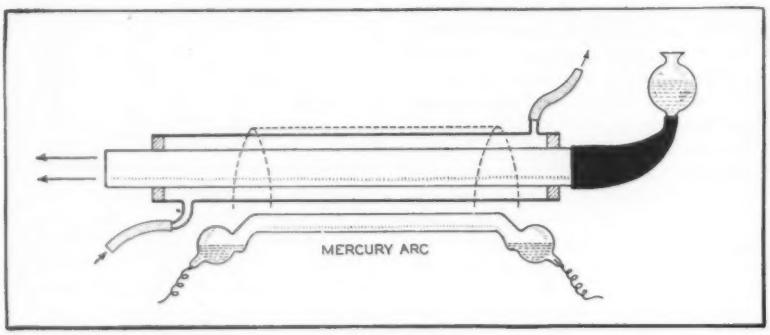


Figure 5

When now one of these quanta enters the benzene, one of three things may happen. It may be diverted from its original direction without loss of energy, giving the line of unmodified wavelength in the Raman spectrum. It may give up some of its energy to a benzene molecule, and emerge from the medium with diminished energy, giving a line on the red side of the exciting line. Or it may abstract a certain definite amount of energy from a molecule already in an excited state—that is, in vibration as a result of temperature—and emerge with increased energy, giving an anti-Stokes line. It is found that the intensity of these anti-Stokes lines increases as the temperature of the medium is raised, as more molecules are then in excited states.

The method of illumination employed by Raman is very inefficient as only a small percentage of the light of the lamp is utilized. The arrangement now universally used is the one described by the writer shortly after Raman's first publication; the liquid under investigation is contained in a glass tube provided at one end with a window of glass fused to the tube, or with a flattened bulb, the other end being drawn off obliquely and painted black. This tube may be surrounded with a second tube in which water circulates to prevent overheating, and the arc is brought up as close to the tube as possible, as shown in the drawing above (Figure 5).

A HALF cylinder of polished aluminum placed over the tubes still further augments the illumination. The scattered light is photographed with a spectroscope pointed down the tube toward the black cone at the farther end. A still further improvement is to use a large glass tube filled with an absorbing liquid which cuts out the light of all but one of the mercury lines, and, acting as a cylindrical lens at the same time, focuses the light on the tube containing the liquid. In this way it is possible to photograph the stronger Raman lines in a few minutes.

A helium "vapor lamp" has also been used by the writer for the excitation of Raman spectra. With a special filter, consisting of a tube of glass colored black with nickel oxide, which surrounded a tube filled with benzene, both being mounted beside the arc and completely surrounded by a cylinder of highly polished sheet aluminum, the Raman spectrum excited by the strong ultra-violet helium line 3888 was obtained.

Three spectra of benzene are reproduced in Figure 6, the upper two by the mercury, and the lower by the helium, arc. They are reproduced as "negatives"; that is, the bright spectrum lines come out dark. The upper one was made with the mercury arc light filtered through a tube containing a saturated solution of a salt of praseodynium, which absorbs the continuous spectrum of the arc in the region where the Raman lines appear and permits the fainter lines to record themselves. The excitation in this case is by the triple mercury line 4358 at the left, and also by 4046 and 4077, which lie still farther to the left and do not appear. The black area at the extreme left is the (over exposed) image of the light of the 4358 triple line scattered without change of wavelength with an intensity of about 500 times that of the strongest Raman line. Lines numbered 1 to 6 inclusive, are excited by 4358, and lines *a* and *b* by 4046 and 4077, *a* and *b* being the same Raman line as 6 by the other excitation. The two lines to the left of 3 are identical with 3, being excited by the two faint companions of 4358, shown as double arrows above the spectrum. Two other fainter mercury lines show to the left of 6. Line 5 is double.

The middle spectrum was made with a quinine filter, which absorbed 4046-4077, and lines *a* and *b* are absent.

The lower spectrum was taken with helium excitation, and is the simplest of the three, as the exciting line 3888 is single. Two faint helium lines have been marked out by covering over on the print.

These are probably the best Raman spectrum photographs that have been made up to the present. Raman spectra have also been made of gases at atmospheric pressure by Rasetti, the writer, and others.

THE first gas studied was hydrochloric acid, contained in a large glass tube about six feet in length mounted in contact with a Cooper Hewitt mercury arc of the same dimensions, the two being surrounded by a hollow cylinder of polished aluminum. The light of the arc, imprisoned by this reflector, was beaten back and forth through the gas tube, securing the maximum intensity of illumination. The spectroscope was pointed so as to "look down" the entire length of the gas tube through a bulb of thin glass blown on the end. With an exposure of only 24 hours a strong Raman line was obtained which was shown by calculation to be associated with the infra-red absorption band of the gas, previously discovered, while the exciting mercury line, scattered without change of wavelength, was bordered on each side by regularly spaced lines which can be shown to be the result of rotation of the hydrochloric acid molecules.

This very important discovery by Professor Raman is opening up a wide field of investigation and throwing new light upon the theory of molecular structure.

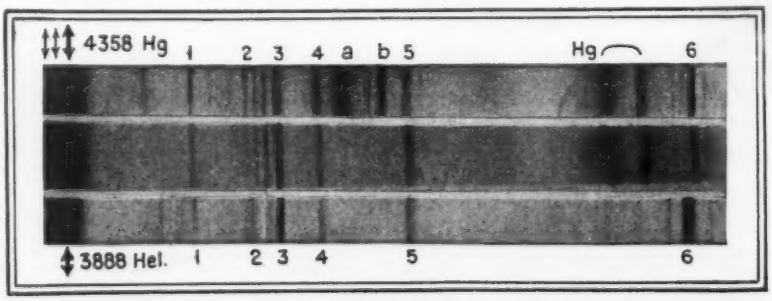


Figure 6

AN ATOM OF LUTECIUM

By NELL RAY CLARKE

FOR the first time the atomic structure of an atom of lutecium has been plotted, this having been accomplished by Dr. William F. Meggers of the Bureau of Standards. The arrangement of the electrons in an atom of lutecium as plotted by Dr. Meggers suggests the nose and wings of an airplane with a radial engine. To Dr. Meggers the arrangement of dots mathematically spaced gave a great deal of satisfaction. He said, "The thrill and satisfaction derived from this discovery may be compared with that accompanying the discovery of the ninth planet of our solar system. Indeed, the lutecium atom is pictured as a solar system with a nucleus, corresponding to the sun, surrounded by electrons which correspond to the planets. However, instead of merely nine major planets which are known to belong to the solar system, the lutecium atom has 71 planetary electrons."

FOR years Dr. Meggers has been working over the riddle presented by the group of elements known as the "rare earths," about which little or nothing is known. The mere names of these elements present for the layman as well as the scientist, perhaps, the most formidable array of unpronounceable words to be found in the English language. Try them out on yourself, if you don't believe it. Here they are—cerium, praesodymium, neodymium, illinium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutecium.

It is only within comparatively recent years that these elements have been isolated; lutecium was isolated in 1907 by the French chemist Urbain. They are for the most part very rare, and although a few of the more common ones have found commercial uses, the rest may be regarded at present as interesting chemical curiosities. They form a unique series of elements, with chemical and physical properties so closely similar that it is exceedingly difficult and laborious to separate them from one another.

A few years ago, the Bureau of Standards purchased for experimental purposes a tiny tube of lutecium oxide from the Welsbach Laboratories in Vienna, almost the only place in the world where it is available. Up to that time, no one had ever worked out the structure of the atoms of a single one of these rare earths. But Dr. Meggers decided to try it, following the lines of

Bohr model of lutecium atom. Orbits of two of the 71 electrons are shown. Diameter of atom is approximately one 50,000,000 inch

the Bohr theory. This had often been attempted before, but Dr. Meggers and his assistant, Mr. Bourbon Scribner, are the first to succeed.

According to Bohr's theory, the atoms, or smallest units of the different chemical elements, are conceived as being built up of positive and negative units of electrical charge, called protons and electrons, respectively. Beginning with hydrogen, which consists of one proton and one electron, the successive addition of protons and electrons explains the structure of heavier and more complex atoms, until the end of the list is reached with uranium which has 92 outer electrons.

First Dr. Meggers had to get the spectrum of lutecium. To do this he impaled some of the lutecium oxide on a piece of wire and passed a current of 220 volts through it to get the spectrum of the neutral atoms. Then by exciting the spark to 40,000 volts he was able to remove one of the electrons from the atom, which gave the lines of the spectrum from the atoms of lutecium with one electron off. Later he got the lines of lutecium with two electrons off; these are in the ultra-violet end of the spectrum and therefore are not visible to the eye though they affect a photographic plate as does visible light.

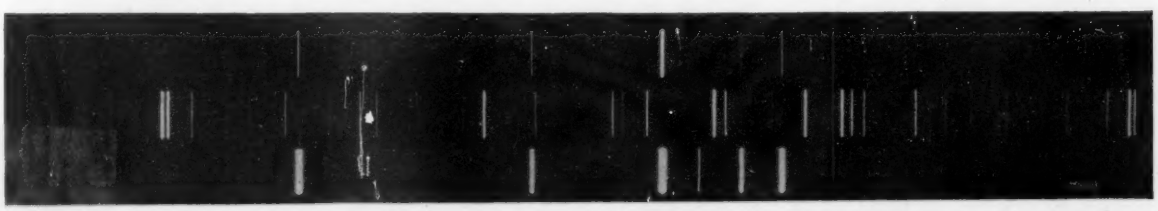
He found that there are 200 lines in the spectrum of neutral lutecium and 450 lines in the spectrum of lutecium atoms lacking one electron. The illustration shows only a few inches of the spectrum; the whole spectrum measures from eight to ten feet in length. The position of each of the lines relative to known wave-lengths in the iron spectrum was measured—a task almost incomprehensible to the layman because of the infinite pains it required.

THE results of the calculations which revealed the regularities among spectrum lines and disclosed the structure of the atom he set down in tiny figures arranged in neat rows. There were enough of them to cover a sheet of paper as large as two card table tops. The graphs he drew to illustrate and explain his work are more complicated than the geometrical designs President Hoover draws during his interviews or while telephoning.

By studying these results Dr. Meggers obtained the solution of the problem of just the exact position of each electron in the atom of lutecium. He is now working upon calculations which will enable him to plot the atomic structure of some of the other rare earths. The spectra of ytterbium, the one being studied at the present time, will be more complicated than those of lutecium, but the atomic structure will be some integral part of the atomic structure of lutecium.

●

A Mexican savant believes he has succeeded in creating living substance, protoplasm, from chemicals. In an early number an account of his intriguing experiments will be described. —The Editor.



A portion of the spectrum of lutecium. The top spectrum is of the neutral atoms; the middle one is an iron spectrum ("comparison spectrum"); and the bottom is the spectrum of lutecium with one of the planetary electrons removed

SCIENTIFIC CRIMINOLOGY—
THE PISTOL WITNESS

By STANLEY F. GORMAN

Lecturer on Bullet and Firearm Identification,
Police College, City of New York

AS a fitting sequel to his article in our October issue, Mr. Gorman has set forth in these pages an actual case taken from the New York police records, in which it is shown how the study of firearms and ammunition is applied in every-day police work. He makes no pretense of telling a mystery story; he gives a bald statement of fact.—*The Editor.*

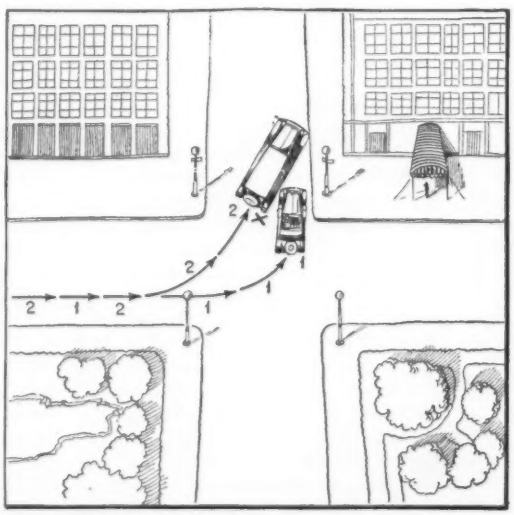
WITH the roar of hard pressed engines, a heavy sedan and a powerful coupé whirled around the corner racing side by side. The sedan suddenly spurted ahead and swung diagonally across in front of the coupé. With a screeching of brakes a collision was avoided and the two cars stopped close to the curb. From the coupé, now in the rear, leaped a man with a gun in his hand. The left-hand door of the sedan opened and a second man, also with a gun in his hand, stepped forth. Shots were fired and a man was seen to leap back into the coupé, back away from the sedan, and speed away from the scene.

THE exact details of what occurred at this recent homicide in New York were beclouded by different versions rendered by different witnesses. According to some, the man in the sedan started to get out the left-hand door, hesitated, and then got out the right side. Others say that he emerged from the left-hand door. In any event, when the police arrived on the scene, the driver of the sedan was found crumpled in a heap directly behind the right-hand rear wheel of his car. It then remained for the police and detectives to make a thorough examination of the scene and from the facts obtainable from witnesses and clues, deduce the facts and bring the murderer to justice.

When the detective arrived on the scene of the crime he found that the driver of the sedan had been removed to the hospital as he was still alive and there were possibilities of saving his life. It developed, however, that shortly after entering the hospital he died. There was a group of about a hundred people surrounding the sedan and held back by the police in charge of a sergeant. The detective found upon questioning the police that the pistol which had been dropped by the driver of the sedan when he was wounded had been carefully picked up by the sergeant. This was done with a pair of pliers in order not to destroy any possible fingerprints. The weapon was placed on the floor of the sedan in the rear compartment so that it would be undisturbed until it could be examined.

Upon examining the gun, which was a 32-caliber automatic pistol, the detective noted that the safety catch was off the safe position, indicating that its carrier had it in readiness for use. With a screw driver the detective pushed the catch to the safe position and picked up the pistol, handling it by means of the screw driver placed through the trigger guard. He then examined it as carefully as possible under the circumstances and looked into the muzzle for powder smudges. He also smelled it for the odor of powder in an endeavor to determine whether or not the gun had recently been fired. It must be remembered that he could not determine whether or not the gun was loaded as this had to be done after the search for fingerprints was made; handling might destroy fingerprints which could be used as evidence. As far as the detective could determine, the weapon had not been discharged, for the barrel contained neither powder smudge nor discoloration and had no burned-powder odor. Furthermore, it was apparently quite wet with oil.

The firearm was then handed to the fingerprint expert who dusted one side carefully with white clay powder and examined the surface. The gun was then turned over and the other side dusted but no fingerprints were found that were distinct enough to be classified. This frequently is the case with pistols because of the difficulty of obtaining a distinct fingerprint on the checked surface of the grip. After the fingerprint examination it was possible to determine whether or not the pistol was loaded. The magazine was found to contain five 32-caliber cartridges, and a sixth cartridge was in the chamber. These cartridges, as well as the interior of the weapon, were covered with oil and an examination of the barrel confirmed the first-formed opinion that the gun had not been fired.



Scene of the deed. The cars are shown in their relative positions at the time of the fatal shooting

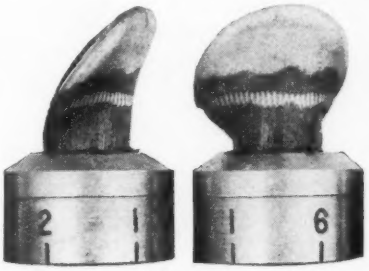
TO return to the scene of the crime: The detective asked for any empty shells found nearby. The police had picked up a 25-caliber shell immediately behind the sedan but this did not completely satisfy the detective. He had been told by witnesses that four shots had been fired and since an automatic pistol ejects its shells immediately as each one is fired, there must be other shells in the vicinity. A careful search soon disclosed three more empty 25-caliber shells.

The next thing to attract the detective's attention was a back cushion, such as drivers frequently use, lying on the running board. Upon asking where it came from and where it was found he was informed that it was lying in the roadway under the running board immediately below the left front door. Apparently it had been dragged out by the victim when he opened the door to get out of the car. This served in great measure to refute the statement

by certain witnesses that the driver of the sedan had left the car by means of the right-hand door. After asking a few more questions, the detective gave orders for measurements to be made of the exact position of the car relative to the curb and the nearby corner. A photographer was instructed to take pictures of the sedan from various positions, and also pictures of the entire block from the corner.

THE detective then went to work to examine the interior of the car for possible bullet holes, commenting upon the fact that, while no 32-caliber shells had been found, it was possible that a shot might have been fired by the driver of the coupé before the man in the sedan got out. His diligence was soon rewarded, for he found a small hole in the cloth lining on the inside of the left front door close to the handle. He carefully cut away the cloth and on tearing the lining he found a metal-patched 25-caliber bullet flattened against the door lock. It had distinct rifling marks and also appeared to have some blood on it when examined under the magnifying glass.

The detective now had in his possession the following knowledge: several conflicting stories told by witnesses; the fact that the back cushion had been found on the roadway under the left running board; the information that four 25-caliber shells had been found on the scene; and that a bullet had been lodged in the left front door of the car. His next procedure was to go to the hospital and examine the body of the driver of the sedan. It was found that a bullet had pierced the left wrist. This wound was accounted for by the bullet which had been found in the door of the car. There were three other wounds on the man's left side and when an autopsy was performed three 25-caliber bullets were removed from the body. Upon microscopic examination of these bullets it was found that each had six land and groove marks (see page 265 October 1930 issue of the SCIENTIFIC AMERICAN), the direction of which ran from left to right. Each bullet also had punched on it a small letter "w" indicating that it was made by the Winchester Repeating Arms Company. This small "w" linked the bullets with



Two views of the mushroomed 25-caliber bullet taken from the car

the shells which were all stamped with the mark of the same company.

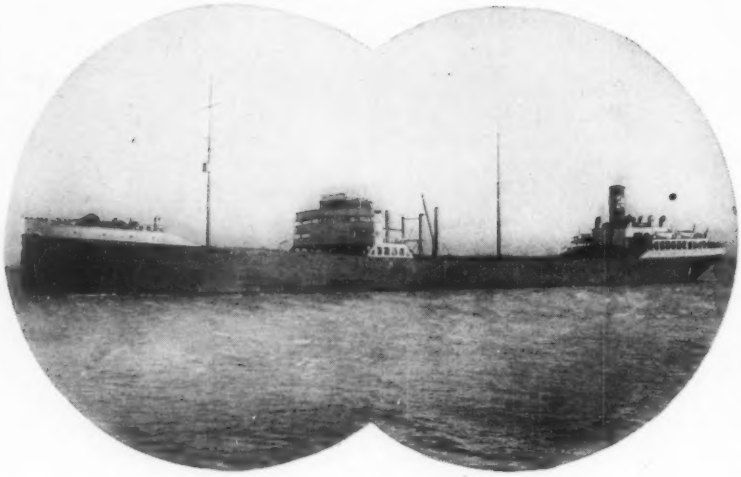
While all this work was going on and the police were busily engaged in building up a case, the driver of the coupé, fearing possible capture by the identification of the car which he drove, consulted with his attorney and decided to surrender himself. This he did, telling an apparently straightforward story of self defense. He claimed that the driver of the sedan had opened fire first, firing two shots at him. The driver of the coupé surrendered both his gun and his automobile. The car bore distinct scratches on the edge of the left-hand mudguard which coincided with scratches on the rear right-hand mudguard of the sedan. The pistol was a Spanish make 25-caliber automatic and was not loaded when surrendered but had powder smudges on the interior of the barrel. Furthermore a strong odor of powder indicated that the pistol had been discharged recently. The gun was turned over to the firearm expert and five test shots were fired into cotton waste. The bullets were recovered and an examination was made under a comparison microscope. It was determined beyond a doubt that the test shots, the three fatal bullets, and the bullet removed from the car door had all been fired from the same gun. (The methods used in reaching this conclusion were dealt with in detail in the October issue of the SCIENTIFIC AMERICAN.) It had already been determined, as described above, that the 32-caliber automatic had not been fired.

The evidence in this case was presented to the Grand Jury and its members were given all the facts determined by the scientific examination of the firearms. They failed to indict the defendant, on the ground that the driver of the sedan had evidently intended to shoot the driver of the coupé and that therefore the latter had acted in self defense. The members of the Grand Jury, however, expressed their interest in the preparation of the case and were deeply impressed by the scientific methods used by the Police Department in determining the facts.

IN order to complete the investigation and mark the case definitely "Closed" it was necessary to establish a motive. It developed that the driver of the coupé, several months prior to the commission of the crime, had delivered a large quantity of grapes to the other party, the value of which was 800 dollars. After repeated attempts to collect this debt, a summons to appear in court was served upon the purchaser of the grapes, who accepted the summons but gave a receipt, as it were, by striking his creditor in the face. The latter's dignity was severely hurt but he decided to use a more effective weapon than his fists. He therefore left as though he was completely defeated but planned a suitable revenge.

He drove directly to his office and took from his desk the 25-caliber automatic pistol. As he re-entered his car he noticed his debtor seated at the wheel of a sedan at a nearby corner. He realized then that he was in for trouble. Suddenly, so it appeared to the man in the coupé, the driver of the other car vanished. This apparent change in the situation reduced the vindictiveness of the driver of the coupé to fear, and he thought it a good opportunity to get away safely. He started away from the curb with a burst of speed and as he passed the sedan he saw his opponent straighten up from the seat where he had been hiding. The sedan too started off at great speed and the race ended as has been told. The customer paid the bill in full. It was he who staggered to the rear of the sedan with gun in hand and fell fatally wounded to the pavement.

The prisoners' pen in the photograph gallery at New York police headquarters. *Center:* Fileing out written records. *Extreme left:* Taking a set of fingerprints



The *Charles G. Black*, one of the largest tankers of the Standard Shipping Company's fleet. She has a tonnage of 20,500, and is 550 feet 3 inches long, 72 feet 2 inches beam

WHEN CRUDE OIL CROSSES THE SEAS

By HENRY W. HOUGH

MORE new merchant ships now are under construction throughout the world than at any time in recent years. The present total of 3,265,929 tons exceeds by more than 100,000 tons the level attained just prior to the World War. This notable peace-time revival in one of the world's greatest industries has been even more marked in the United States than in other maritime countries. The tonnage of new vessels under construction in American shipyards still is only about one eighth of that laid down in yards in Great Britain and Ireland, but during the last quarter, the United States advanced from fifth place to third, and now is hard on the heels of Germany, which holds second place in the tonnage of new ships being built.

Amid this quickening interest, particularly notable is the recent impetus in the construction of tank ships. The increase is attributed to the world-wide and ever-increasing demand for petroleum products and other bulk cargoes, such as creosote, molasses, coconut oil, turpentine, whale oil, and vegetable oils. By far the most important of these liquid cargoes is crude oil. Much gasoline, fuel oil, and other refined petroleum products also are transported in "tankers."

Of all the new tankers now under construction in America and abroad, perhaps the most interesting are the two new 18,000 ton ships being built at the Kearny, New Jersey, works of the Federal Shipbuilding and Dry Dock Company. These vessels are being constructed for the Standard Shipping Company, marine subsidiary of the Standard Oil Company of New Jersey, which owns and operates the world's largest tanker fleet. With the additional ships now being built, this great fleet will comprise 106 ships aggregating 1,105,528 tons, operating in all parts of the world but especially in American inter-coastal traffic.

The two new Standard tankers are said to represent the "last word" in design and equipment, and are expected to show a substantial saving in operating costs as well as in the initial investment. Their construction is being watched with interest by those interested in ships of this kind, because of a number of departures from standard design which are being incorporated.

THEY are 544 feet in length, 74 feet in width, and 40 feet in depth, with a draft, when loaded, of about 28 feet. They are single-screw ships, and will operate at an approximate speed of 11 knots per hour when loaded to capacity. Both are being powered with De Laval cross-compound steam turbines equipped with double-reduction gears of recently improved design, made by the same manufacturer.

Oil-fired Babcock and Wilcox water-tube boilers will supply the turbines with superheated steam under 400 pounds pressure at 750 degrees, Fahrenheit, at the superheater outlet. All of the ship's auxiliary equipment will be operated electrically, including the cargo pumps and steering gear. Two 300-kilowatt turbo-generators will provide the electricity. These power plants follow the practice which has proved most satisfactory on land in central power station service, with turbines operated by steam at high pressures and high temperatures and the auxiliaries operated by electricity.

Perhaps the most interesting of the new features incorporated in these tankers is the revised arrangement of the boilers. Instead of placing the boilers in front of the turbines, as is the customary practice, they are located aft in the narrower part of the stern. The additional space made available by the new arrangement is of exceptional value in ships of this type, because of the tankers' characteristic location of the propulsive equipment in the stern, where the curving hull reduces the available space required for the various auxiliaries of the engine room.

In addition to increasing the space in the engine and boiler rooms, this arrangement permits the use of a flexible propeller shaft nearly three times the conventional length. A high degree of flexibility between the turbine and the propeller shaft is considered one of the paramount characteristics of an efficient marine power plant.

These new tankers are being equipped with the already famous "contra-rudder" and "contra-propeller." By using these stream-lined propeller hubs, stern-posts, and partially balanced rudders, an appreciable saving in fuel costs will be effected. At the former fuel consumption, the speed of ships is increased from 5 to 10 percent with this equipment. In addition, there is a reduction in torque on the rudder of from 30 to 40 percent, which reduces the strain on the steering gear and makes it possible to maneuver the ship more easily.

Tank ships are constructed with a number of compartments, formed by horizontal and longitudinal bulkheads.

In the average tanker, the compartments are arranged as follows, working back from the bow: fore peak tank; fore hold for package freight and a tank for water ballast; cofferdam; cargo tanks; pump room; cargo tanks; cofferdam; bunker for fuel oil; space for boilers and machinery; and fresh water tanks. In addition to the deep cargo tanks, there are also "summer" tanks. These are long, shallow compartments situated above the deep tanks along the sides of the ship. They are used when carrying light cargo such as gasoline or naptha. Some tankers are built with two longitudinal bulkheads instead of one, forming a greater number of compartments of decreased width.

THE cargo pumps, usually located amidships, naturally vary in size and number according to the size of the ship. The output of each pump ranges from 150 to 400 tons per hour. The customary discharge pressure is between 50 and 100 pounds per square inch. In many installations, the ship's pumps are operated by steam, as are the winches, windlass, and other auxiliaries. In the new Federal-built tankers, all such equipment is electrically operated.

The pumps are used for unloading, "trimming," equalizing the cargo in the various tanks, and taking on and unloading water ballast when the ship is otherwise empty. When taking on a cargo, pumps on shore do the loading except in ports where gravity pressure can be used.

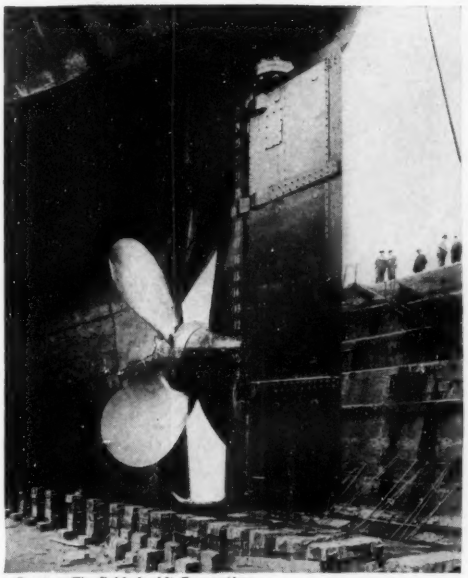
To load a ship properly with a liquid cargo is a task which requires real teamwork, good judgment, and long experience. Should the officer who is supervising the loading fail to give the shore pumpman the signal at just the right moment, the tanks may take on the appearance of miniature gushers. Cleaning the deck is not a pleasant task, after such an occurrence, and of course to lose oil is to lose money. More important, however, is the necessity of keeping the overflow from contaminating the water near the loading dock. To pour oil on the waters is an unpardonable offense in any port.

It requires only five or six hours to load or unload the largest of the oil tankers, some of which have a capacity up to 150,000 barrels. Consequently, ships of this type are able to spend practically all their time at sea, with waste time reduced to a minimum.

American oil was transported across the Atlantic ocean as long ago as 1861. Before the days of steamships, tankers were busily crossing the seven seas.

For a long time, domestic transportation of petroleum and its products was handled almost exclusively by river barges and railway tank cars. With the construction of extensive underground pipe-line systems, it seemed that oil could be transported almost any distance by that method. Economy, however, added another chapter to the story.

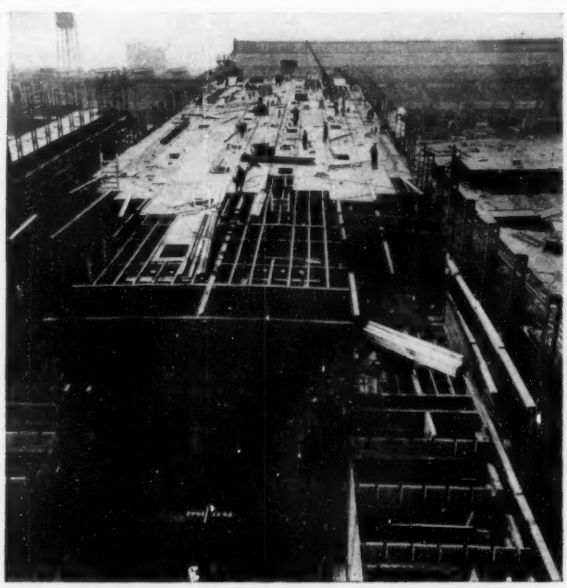
The longest of the oil pipe-lines was a 1700-mile trunk line extending from the mid-continent fields to Bayonne, New Jersey. Originally it was an oil line, transporting the raw material from the oil fields to refineries on the eastern seaboard. Now it transports gasoline—the finished product—from the eastern refineries to one of the most important consuming areas in the middle-west. Thus the order of supply is reversed, for the oil companies have found it more economical to supply their eastern refineries with crude oil brought by tanker from pipe-line terminals at ports in Texas, Louisiana, California, Mexico and elsewhere—a task for which these new tankers will soon be launched—and pipe the finished product into the interior. "The old order changeth, yielding place to the new."



Courtesy Th. Goldschmidt Corporation

Contra-rudder and contra-propeller, the stream-lined design of which saves much fuel

Construction of cargo tanks of a new Standard tanker, with longitudinal and horizontal bulk-heads in place



Later view of construction of tanker with tanks partially covered with plates, and apertures for filling and emptying

TRAVELING HOME FOR 'PHONE LINEMEN

By C. W. GEIGER

NO longer does the lineman whose duties take him to the wide open spaces and the sagebrush wastes of Nevada have to shiver through long nights in zero weather. No longer does the truck driver have to haul water 14 miles to camp. No longer—ah, well, the old-timer who did his hitch in '14 when they built the T-C lead shakes his head and mutters something about times not being what they used to be. He mutters something about the coming generation getting softer, or having it soft, or some such remark that betrays a bit of wistful reminiscence rather than envy.

For today telephone men in the sagebrush country are residing in "private" cars. They are real, honest-to-goodness private cars. These cars were purchased by the Pacific Telephone and Telegraph Company from the Southern Pacific Railroad Company and remodeled under the supervision of the telephone company.

FOR many months construction crews from California have been "farmed out" on the desert. With the completion of each job, however, a new one was devised, for work in the Silver State is no longer a seasonal activity, and the growth of the telephone business has demanded all-year activities.

When it is 10 degrees below zero, Nevadans consider it a light frost, so with the ever-increasing demand for telephone circuits, some steps had to be taken to provide adequate living quarters for Californians engaged in desert work. When it was definitely decided what was required, the Supervisor of Supplies of the Pacific Telephone Company began negotiations with the Southern Pacific Railroad Company and, as a result, the linemen now have a complete "home sweet home" of seven cars, comprising material, water, commissary, kitchen and dining, recreation, sleeping, and foreman's cars. The whole unit will take care of 40 men.

The Threlkeld Commissary Company, which provides the meals, occupies one car, remodeled to provide a commissary and sleeping quarters for the Chinese cook and the waiter. From this car the kitchen help can walk into the dining car, which has been rebuilt to provide a kitchen the full width of the car with an adjacent horseshoe counter.

Following the dining car is the recreation or club car, which is equipped with a radio and tables for cards and reading. What was formerly the kitchen of this car, when it was in active service on the railroad, has been remodeled into a bathroom de luxe, featuring heating arrangements better than some bachelors have at home. Forty minutes before the "gang" gets in the car to "ablute," the "Chief Steward" starts the works and then—hot water for everyone. For the more fastidious, there are tub and shower baths.

These comfortable, clean berths are a vast improvement over the camp quarters formerly used

After the recreation car comes one of the sleeping cars, which is provided with double deck berths the full length of the car. The next car is the foreman's car, equipped with single berth cots, and, located at one end, the foreman and clerk's sleeping and office quarters.

A two-kilowatt automatic lighting unit furnishes the electricity for lighting. When any light is turned on, it automatically starts the motor and instantaneous lighting is then furnished throughout the cars as required. Turning off the last light stops the motor. To provide water throughout the train, a pressure pump has been installed, hooked up with the lighting unit. This scheme gives water pressure equal to the usual city pressure.

The railroad car home is indeed a tribute to the efforts of the management of the telephone company to provide adequate protection and accommodations for those whose duty takes them to the barren wastes.

Another and similarly equipped special train with 80 men on board is being used in building a long-distance telephone line across the sands from Barstow to Las Vegas. The project, involving 826,000 dollars, will provide 85 simultaneous talking circuits between southern California, the Hoover Dam territory, and certain desert towns that have never yet had telephone service. The circuits will be extended later to Salt Lake City. Pressing telephone requirements have developed in this section of the west, and the specially equipped construction train departed as the best answer for the situation.

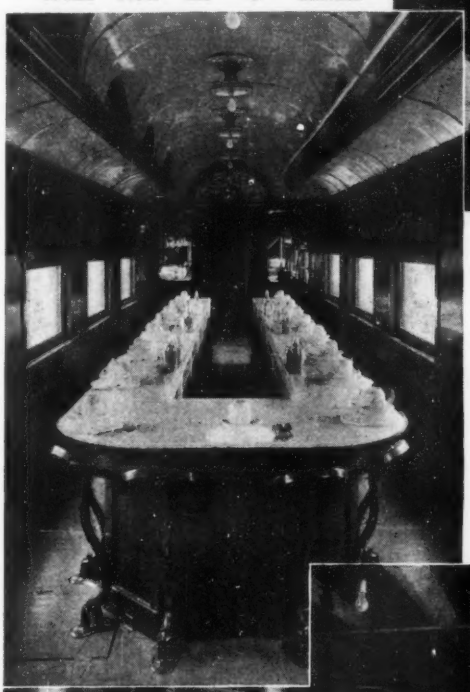
INCLUDED in the train are three sleeping cars, a dining car, a commissary car, a bath car, a supply car, and a water car. Although the men will be in the warm environs of the desert for several months, each day's toil will be forgotten in the 12 shower baths in the bath car.

The men have their own lighting system aboard, together with electric refrigeration. Ice cream sundaes on the fringes of Death Valley loom as possibilities, according to the head of the commissary department, who has planned to deliver approximately 20,500 meals to the hungry workers while en route.

Electric fans are also installed in each of the coaches. The dining car contains a table more than 60 feet long, capable of seating the entire personnel. The club car contains regular day-coach chairs, card tables, a phonograph, and other equipment to make the desert headquarters home-like. The train was purchased by the telephone company and the interiors of the coaches were refitted to suit the needs of the expedition.

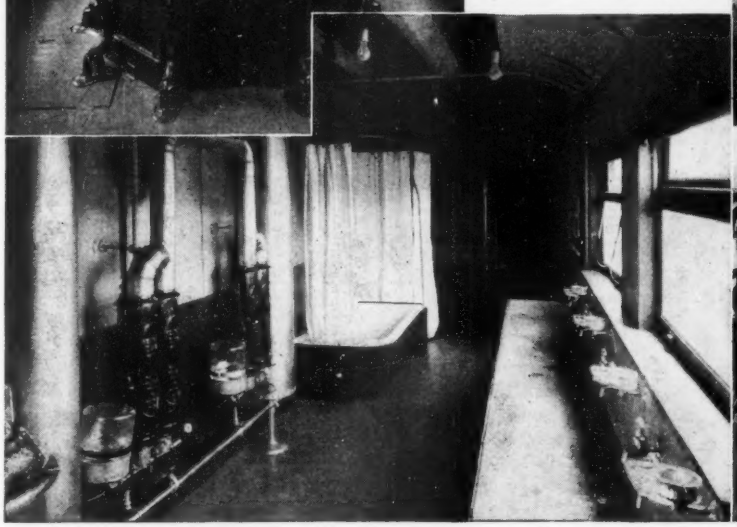
These modern telephone pioneers began their activities just east of Barstow. Augmenting the telephone train are 10

Below: When the dinner bell rings, out on the desert, this is a busy room. Note the "U" counter



The important room where harmony and contentment among members of the crew are insured: the kitchen car, a Chinese cook, and a waiter

Below: The wash room on the telephone construction train. The equipment consists of a long sink with many faucets, tub and shower baths, and hot water heaters for the baths



Below: After a hard day's work, the crew finds relaxation and entertainment in the recreation car which is very popular

new motor trucks ranging in capacity from 1½ to 10 tons each, four tractors, and several congenial Missouri mules that are to add the color of the past to the expedition.

More than 12,000 poles and crossarms will be used in constructing the 10-wire copper span across 150 miles of desert country. Pyrex glass insulators, numbering 160,000 will be used for the first time and provision has been made for 90,000 feet of guy wire.

The construction men are building approximately two miles of long-distance line daily. They sleep in a different spot practically every night. A farewell comparable to some of those enacted at railway stations during the World War took place when the train left its siding in Los Angeles and the families of the 80 telephone men bade them goodby.

The efficiency of the preparations made for this great project, and the amount of careful detail that has been worked out in connection with the expedition, caused a great amount of comment in southern California. As a result of the work of these men in the desert, the east and the west will be brought into closer contact, and provision will be made for the rapidly increasing long-distance telephone traffic between the people of the Pacific Coast and their friends and business associates across the Sierras.

Noteworthy, also, will be the part that this long-distance circuit will play in the construction of Hoover Dam.

AVIATION IN 1930

By PROF. ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York University
Associate Editor, *Scientific American*

AIRSHIP enthusiasts have been greatly encouraged by the year's developments. In Akron, under the auspices of the Goodyear-Zeppelin Corporation, the 6,500,000 cubic-foot airship *Akron* is advancing rapidly. Seven main frames, and 18 intermediate frames are in position, representing 525 feet of the ship's total length of 785 feet. This dirigible has been called the "airship of 6,500,000 rivets"; stood on end it would be equivalent in height to a skyscraper of 80 stories.

Driving rivets in the airship is not the noisy process we associate with the construction of a skyscraper. The dural rivets, heat-treated in an electric furnace, are taken from the furnace, immediately quenched, and then simply squeezed into position by a manually operated tool.

The airship is to be delivered to the Navy Department in the spring of 1931. With its swiveling propellers, speed of 80 miles per hour, and unequalled dimensions, the *Akron* will mark a distinct epoch in airship development.

THERE are at present only two airship building corporations of importance in the United States. One of these, the Aircraft Development Corporation of Detroit, is actively pursuing its experiments with the metal-clad type of airship in which a thin metal covering, about eight thousandths of an inch in thickness, replaces the conventional rubberized fabric covering of today. The metal-clad airship built by this company and delivered to the Navy's Airship station at Lakehurst, has shown up excellently in service and has successfully demonstrated that the difficulties expected from the very thin metal covering are really non-existent.

It is understood that the duPonts, in conjunction with yet another lighter-than-air company, are producing a synthetic material which will replace the expensive goldbeaters' skin (made of animal entrails) and will reduce the permeability of the gas bags to helium to an almost negligible quantity.

Small airships for private or commercial use have been few in number to date. They have possibilities, however, and it is intriguing to learn that Captain Anton Heinen, the airship pilot employed by the Navy Department in the construction and operation of the *Shenandoah*, is planning to build a number of small airship yachts. These little airships are to be only 104 feet in length with a gas capacity of 39,600 cubic feet. They are designed to have a top speed of 65 miles per hour and are to cost less to operate than an automobile! The plans also call for the use of a detachable passenger car which can operate under its own power as an automobile. This of course would meet the great difficulty of transportation to the airport. It remains to be seen whether the technical difficulties involved in such independent operation can be overcome.

ALTHOUGH the general business depression during the past year has affected aviation adversely, the developments within the industry give promise of a bright future. On these pages Professor Klemin presents a brief yet thorough survey of the situation.—*The Editor.*

Still another encouraging feature of the airship situation is the fact that the proposed airship line between Spain and South America, under combined German, Spanish, and South American auspices, is apparently coming to a head. At any rate Captain Eckener, full of energy and enthusiasm after his successful voyage 'round the world, has definitely begun the construction of an airship for this service. The new airship, the *LZ-128*, is to be finished by the end of next summer. She is scheduled to be 815 feet in length, with a maximum diameter of 130 feet, and a displacement of 5,250,000 cubic feet. Four power gondolas are to be placed on each side of the airship, each equipped with two Maybach motors of 500 horsepower. The airship is planned to be used mainly for mail purposes and is not to be equipped with any degree of luxuriousness. The Spain-South America line is regarded as an even more promising field for the airship than the Germany-Lakehurst route, because the saving of time over the 17-day steamer service is likely to be overwhelming.

The British, on the other hand, are more than satisfied with the flight of the *R-100* from Cardington to Montreal and back. The voyage from east to west, beginning on July 29th, took 79 hours of flight, with eight hours delay due to repairs in flight. The return trip of 57 hours 5 minutes was very close to the record time of the *Graf Zeppelin*. The *R-100* navigated successfully through fog, and when it was encountered on the voyage also demonstrated the success of a very useful new device whereby water deposited on the cover was collected by a series of special drains leading to a cistern. More than two tons of water were collected in this manner in the course of one morning. This ship was constructed by the Airship Guarantee Company of which Commander Sir C. Dennis Burney is the guiding spirit. As the result of close analysis and of the experience achieved in this successful voyage, Commander Burney predicts large profits on the investment in a regular line.

THE trip of the *R-100* constitutes the eleventh crossing of the North Atlantic by airship, with some minor mishaps it is true, but with not a single fatality on any of the crossings. There would appear to be a good deal in favor of the opinion that the airship is a suitable medium for trans-oceanic travel.

The year has been marked by comparatively little news of helicopter development—with one outstanding exception, the announcement of completion of the Curtiss-Bleecker Helicopter.* The possibilities of the helicopter or direct lift type of aircraft are very great. It is obvious that the ability to rise vertically from a small plot of ground and to land at will in equally restricted territory is very valuable. While it is inconceivable that the helicopter should compete with the airplane for load carrying at high speed, it would be a very valuable auxiliary in air transport work. For military or naval air forces the helicopter's ability to hover over one spot would ensure accurate and deadly bombing. With these possibilities in mind much money and effort and ingenuity have been spent in all civilized countries on the production of a helicopter. Nowhere have really conclusive results been yet reached.

*For a description of this helicopter see *Scientific American* September, 1930, page 214.

As aeronautics progresses more and more, it cannot be expected to provide us with so many thrilling novelties as in the past. Still there have been a good many novel developments even in this year of general aeronautical depression. One of the most striking is the provision of a parachute for the support of the entire plane, developed by the Russell Parachute Company and successfully tested on a Parks biplane of the Detroit Aircraft Corporation.†

On the first test, the ship landed in a tree, yet the only damage sustained was that of a broken propeller and a bent landing gear axle. There is no doubt that if the plane 'chute proves entirely practicable it will add greatly to the confidence of the traveling public.

AT the same time manufacturers are not neglecting other ways of providing parachute facilities for the traveling public. For example quick-release parachutes have been successfully tried out in recent months. (See page 392, November, 1930, SCIENTIFIC AMERICAN.) The traveler is provided with a comfortable though sturdy jacket at the front of which there is a ring. The parachute is placed conveniently at hand in the cabin; a hook on the parachute can be attached to the ring in an instant. It is true that only a short time ago a girl of '6 jumping from a cabin plane forgot to pull the rip cord and was killed, and it is true that passengers as a group will not take readily to the parachute. Still its possibilities in emergencies are well worth experimenting with.

†For full description see *Scientific American* Digest, this issue.

The only type of aircraft we can recall which may be classed as completely a novelty is the rotor seaplane recently built at Mamaroneck, New York. Considerable mystery attaches to the construction of this seaplane. Instead of the ordinary wings, two cylinders or rotors are placed above and on either side of the fuselage, and are turned by suitable gearing from an engine placed in the fuselage; a second engine drives a conventional propulsive propeller. When the rotors are turning and the seaplane as a whole is in forward motion the rotors give a powerful upward or lifting force. Their action is similar to that of the Flettner rotors used in the Flettner rotorship, *Buckau*. While the daily press grew quite excited about the possibilities of the rotor airplane, it must be remembered that while rotors are very powerful in lift, far more powerful than ordinary wings of the same area, they are also far less efficient. That a rotor airplane can be made to fly is quite likely. That a rotor airplane can be made reasonably efficient is very doubtful. (For a fuller description, see page 392, November, 1930, SCIENTIFIC AMERICAN.)

The year's activity in design, although somewhat curtailed by the general slump in aviation, has brought out several new types of planes. The Daniel Guggenheim Safe Aircraft Competition was instrumental in bringing out the Curtiss *Tanager*, the prize winning plane of the competition. This plane has brought several fine developments to the eyes of the designer, notably the slots, flaps, and floating aileron. The added lift and speed range due to the slot and flap combination has proved very encouraging. (For details of the *Tanager*, see page 232, March, 1930, SCIENTIFIC AMERICAN.)

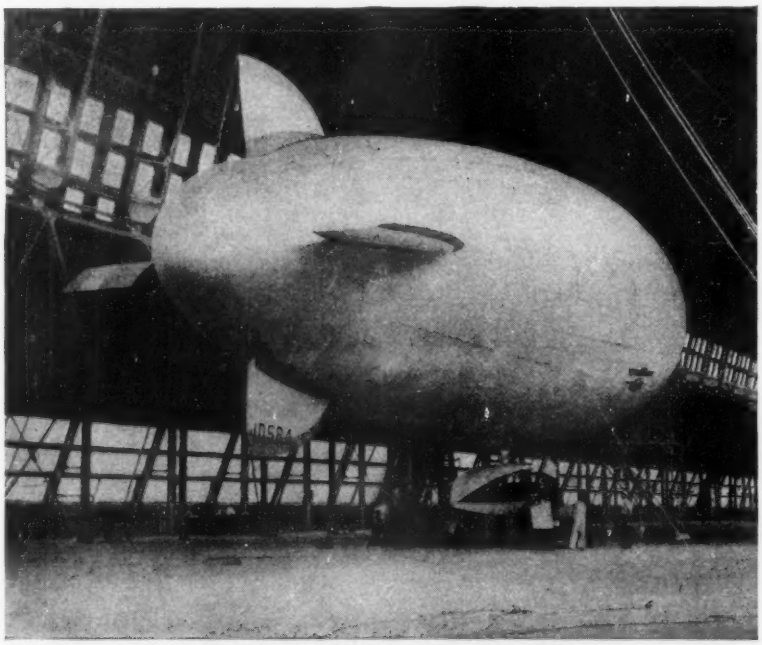
In the light racing and sport plane field, the *Mystery S*, a low wing monoplane designed by the Travel Air Company, has created quite a stir. The *Mystery S* is a typical low wing monoplane streamlined to the highest possible degree. It has incorporated every known device for the reduction of drag such as tapered wings, wheel fairings, elliptical fuselage section, and filleting of all sharp corners. The streamlining of the fuselage is carried through to the rudder, the bottom of which conforms with the shape of the fuselage. The amount of external bracing has been cut to a minimum and where necessary it has been done through use of streamline wire. The landing gear of the *Mystery S* is of unique design.

The shock-absorber strut is a combination oil and spring type held in a vertical N Strut which is attached to a wing stub. Each unit of the landing gear is fastened to its own wing and the wing stub of the opposite side. Most of the wheel and mechanism are enclosed in a neat fairing. The plane attains speeds in excess of 200 miles per hour equipped with a special 400 horsepower Wright Whirlwind. Many of the small ship manufacturers have followed in the steps of the Travel Air Company and are developing small fast planes but this ship still remains as one of the swiftest and neatest of designs.

A DECIDED trend toward increasing the payload with increase in size of the ship has been confirmed by the construction of several large ships. There is the Junkers *G-38* which has undergone several successful flights at Dessau, Germany. Although the construction of the *G-38* is of usual Junkers metal type, the depth of wing is such that the power plants and cabin passenger accommodations are wholly contained within it. Propellers are mounted out in front of the wing on streamlined bosses and driven by extended shafts from the motors. The plane will carry 32 passengers together with a cargo of freight and mail. Passenger cabins in the wings are available.

In America, the Fokker Company has developed the *F-32*, a large monoplane of usual Fokker construction carrying 32 passengers and having a payload of 8700 pounds. The plane is driven by four motors in two tandem pairs mounted out under the wings. Passenger accommodations are very luxurious and are capable of being made up as a Pullman for night service.

The Commodore flying boats which have been constructed by the Consolidated Aircraft Company and put into service on southern routes of the N.Y.



One of the air-yacht dirigibles designed by Capt. Anton Heinen, prominent airship pilot, mentioned in the text. It is planned to produce them in quantities

R.B.A. Lines are also additions to the large plane class. These planes are luxuriously equipped for 20 passengers and can be made up for night service.

In the aerodynamics of the airplane there have been no revolutionary changes, but steady refinement and improvement. The ideal of the airplane designer is a flying wing, with everything enclosed as far as possible in the wing itself. The Northrup Company, of California, has carried us a step nearer this ideal. Northrup has designed a pusher airplane, very heavily tapered from root to tip, so that the root of the wing is quite thick, so thick in fact that the small nacelle in which crew and engine are placed is practically hidden in the wing. The Northrup *Flying Wing* is a pusher, with the propeller mounted behind the wing, and the tail surfaces carried on outriggers running from the wing. This is a decided step forward. (See page 389, May, 1930, SCIENTIFIC AMERICAN.)

Vincent J. Burnelli has continued his experimental work with a transport plane in which exceptional cabin space is provided. The Burnelli fuselage is twice as broad as the conventional fuselage, but it is given an airfoil form and thereby contributes to the lift. At the same time the two engines are mounted inside the fuselage, at its leading edge. It is claimed for the Burnelli principle that the relatively enormous passenger space is obtained without any sacrifice of aerodynamic efficiency.

THE Fokker Aircraft Corporation has also been working in the direction of the flying wing. A bomber recently tested has its cantilever wings of such thickness that the fuselage fairs completely into the wing at the root. At the same time the two Curtiss Conqueror engines also merge completely into the thick wing.

In the Boeing mail plane, the *Monomail*, a retractable chassis is another method of reducing resistance.

In discussing thick tapered wings, which provide such excellent spar depth to resist bending moments, it is often said that the drag of the thick wing must be greater than that of a thin wing with external bracing. We have the authority of R. J. Minshall of the Boeing Company for the statement that tapered wings are now available which have an intrinsic profile drag no greater than that of the thin wing of the past.

Another aerodynamic development which is meeting with increasing favor is the Townend ring. This is a simple ring a few inches in width, and of slight curvature along its width, which is made to surround the radial air-cooled engine. The Townend ring smoothes out the flow when broken up by the projecting engine cylinders and enables the air to keep streamline contact with the fuselage. The Townend ring achieves the same purpose as the somewhat more complicated Venturi cowling, and is much simpler to build.

In those landing gears which are not retractable, designers are making efforts to reduce resistance by putting "pants" or "spats" over the wheels or by using cantilever struts, just one strut to a wheel instead of the two or three struts previously employed. Some designers have tried fairings which enclose both struts and wheels. Another aerodynamic improvement consists in the use of fillets between wing and fuselage. Experiments at New York University have given an exact rule for the design of such fillets or fairings.

In general the airplane is rapidly approaching its ideal streamline form.

ONE of the most important problems engaging the attention of airplane designers to-day is that of metal covering instead of fabric covering for both the wings and fuselage of an airplane. Fabric covering has the disadvantage of poor maintenance and durability. Metal covering is unfortunately very heavy, even if the thinnest sheet is employed. Since the airplane is under very strict weight limitations, it is only desirable to use metal covering provided the covering itself contributes to the strength. Unfortunately thin metal sheet will not develop anything like its theoretical strength because of local failure termed "crinkling" when the sheet is in compression. The Navy Department and the Army Air Corps are both giving much attention to the problem of the metal-covered fuselage, and in time disconnected efforts of various designers should lead to more accurate knowledge.

The large airplane of the future should have a structure similar in some respects to the structure of the ocean liner, in which the metal plating is already so thick that it can be confidently taken into account in the calculations of strength.

One of the most marked tendencies in the aircraft engine development for the year was the increasing number of inverted, in-line, air-cooled engines of the lower horsepower range which appeared. At both the St. Louis and the Detroit aircraft shows this type of engine was well represented.

Among the newer ones of this type we have the Chevrolair D-6, a six in-line, manufactured by the Chevrolair Motors, Inc. The engine is rated at 170 horsepower at 2000 revolutions per minute. Another of the interesting engines of the inverted type is the Hi-Drive Ensign engine manufactured by the American Cirrus Company. This is equipped with a DePalma super-charger and is rated at 110 horsepower at 2100 revolutions per minute.

THE Fairchild Aviation Corporation have also introduced an inverted six in-line of 110 horsepower.

Engines of this type (inverted in-line) are somewhat heavier than radials of the same horsepower, but their greater simplicity, easier accessibility, better stream-lining and vision qualities are making them more and more popular.

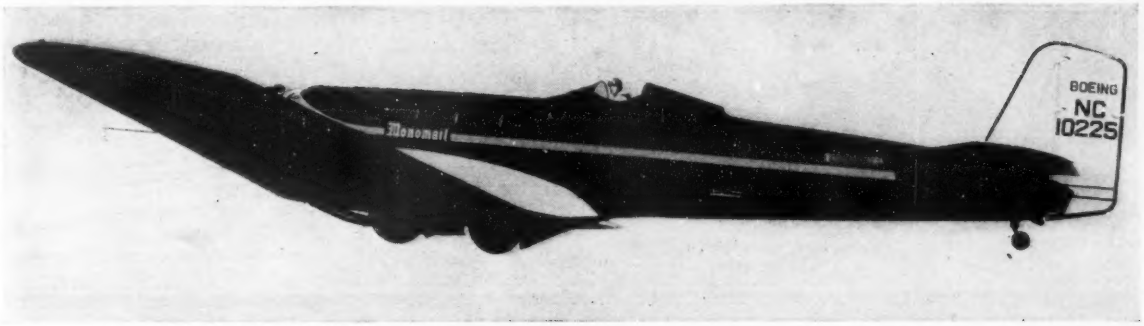
The Packard Diesel, over its first trial stages, is apparently finding acceptance among the aircraft designers and builders. Several transports, including Ford tri-motor and others, have offered planes using this engine.

The L-head engine so popular in the automotive field, has lately entered aviation. The MacClatchie Manufacturing Company has placed a seven cylinder, radial, L-head engine on the market. The difficulty of cooling these L-head air-cooled engines has apparently been overcome in this engine. It develops 150 horsepower at 1900 revolutions per minute and weighs 400 pounds.

Another interesting development among the aviation engines is the increasing number of two-cycle engines that are making their appearance. Several small motors on this principle, of about 30 horsepower, designed for the light plane, have been developed.

The two-cycle engine undoubtedly has great possibilities in the air-

A striking view of the *Tanager*. The floating ailerons and the wing flaps are plainly visible. This particular plane was destroyed by fire while on the ground



The retractable landing gear on the *Monomail* is said to add 25 miles per hour to the plane's speed

craft field. This is especially true in regard to Diesels. The two-cycle Diesel offers many advantages over the four-cycle gas or oil engine or the present two-cycle gasoline engine. The present two-cycle design has four disadvantages: poor scavenging, delicate mixture control, low volumetric efficiency, poor fuel economy. The so-called "solid injection" of fuel would probably remedy this. The four-cycle Diesel has the disadvantages of weight, high consumption of lubricating oil, and mechanical complications.

THE year has witnessed remarkable record-breaking performances. The re-fueling flight of the Army plane *Question Mark* ushered in a contest to see which plane could stay aloft the longest. Notable among the many flights was that of the Hunter Brothers at Chicago who stayed up for 553 hours in a Stinson *Detroiter*.

Their record was broken by the former record holding team of O'Brien and Jackson who regained their title by staying in the air some 743 hours in a Curtiss *Robin* plane. These flights proved beyond all doubt the feasibility of long, refueling flights.

Two other record breaking flights were made during the year. The first of these was that of Lieut. Apollo Soucek of the United States Navy who reached an altitude of 43,166 feet in a Wright *Apache* plane. The Navy personnel had been experimenting for more than a year on improving the performance of the plane and no factor was overlooked which might raise the ceiling of the plane. When a study of the research data is complete the flight will assume a greater meaning to aviation.

The second flight was that of Capt. Hawks who put up a new trans-continental record in his 12¼ hour coast-to-coast flight. The flight was made in a Travel Air *Mystery S*, the actual air time being 11½ hours, three quarters of an hour being consumed in three refueling stops.

One of the reasons for the disappointing showing of the aviation industry this year is the slow growth of private flying. The reasons are easy to find. In spite of the results of the Guggenheim Safe Aircraft Competition, few manufacturers have sought to embody in their airplane designs the latest aerodynamic safety devices. Well-informed opinion is that while planes are much safer than they used to be, they are still far from the ideal.

Airports and fields are much more numerous than they used to be, but still far from being immediately accessible. A plane is expensive to purchase and expensive to maintain. All these obstacles will disappear, but they have not disappeared as yet. The position of the private plane owner is not at all that of the automobile owner but rather that of the motor-boat owner a few years ago, who had to exercise skill, knowledge, and determination to derive pleasure from his craft.

A RECENT survey of the situation by *Aviation* gives a very fair picture of existing conditions. The typical private plane owner of to-day is a man in his early thirties, with an average income of about 8000 dollars a year. There is no typical occupation for the plane owner. He may be an advertising man, a junior executive, a broker, publisher, or salesman. He flies because he likes it.

Those men who purchase airplanes from a business point of view seem to find their investment a disappointing one. The average monthly flying time is only 13 hours and 24 minutes or about 160 hours a year. Flying is generally a matter of Saturday afternoons and Sundays. Some owners turn their craft over to professional pilots for passenger-carrying work during the week in order to defray expenses. Crack-ups are fortunately few. The enthusiasts who fly for pleasure know their business as a rule and they are not under compulsion to fly in all weathers as are air-mail pilots, for example. With this short flying time per year, and the rapid obsolescence of the modern plane, the question of "trade-ins" will certainly bother the trade in the very near future.

Owners find the maintenance of their craft quite onerous; as it is always necessary to inspect control wires, gas lines, landing gear, and so on, some 28.6 percent of the owners employ professional help.

The most popular type of privately owned plane is the three-seater open cockpit machine, with an air-cooled engine of between 150 and 225 horsepower. It is expected that the cabin plane will take the place of a good many of the open cockpit machines, and manufacturers are anticipating this change in demand. In spite of the fascination of the flying boat and amphibion, few private owners purchase such craft. The drawback is in expense. It is gratifying to see that a few manufacturers are turning their attention to inexpensive amphibions.

Aviation country clubs are a splendid social outlet, but the expenses of membership added to the flying expenses have checked the growth of this type of organization. The most promising line of attack would be the formation of flying clubs on the English model clubs where inexpensive, low-powered machines are employed, general expenses are restricted to essentials, and no attempt is made to provide a luxurious social atmosphere. The many English flying clubs have of course been fostered by direct government subsidy.

THE present status of aviation safety is naturally a matter of considerable public interest. Perhaps the most authoritative statement on the subject yet issued is the Report of Committee on Aviation Statistics of the Actuarial Society of America, which was compiled with the co-operation of many governmental and private agencies. It is impossible to present even in summary the findings of this report, which deals with every aspect of the subject, but the comparison with railroads will give a graphic view of the situation.

The Accident Bulletin of the Interstate Commerce Commission for the year 1928 shows a rate of .003 passengers killed per million railroad passenger miles. Only about one fifth of these

(*Please turn to page* 488)

THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

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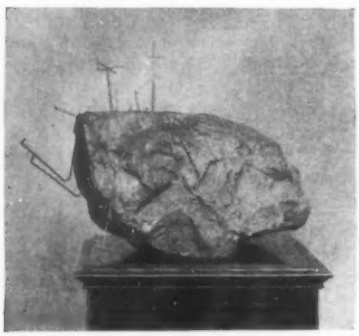
HUGE LODESTONE SPECIMEN

AN extraordinary specimen of lodestone, weighing more than 400 pounds, and possessing unusually powerful magnetic strength, has been placed on exhibition in the department of geology at Field Museum of Natural History. The huge natural



The average boy who likes to mystify his friends would give his last cent for a small piece of this 400-pound natural magnet from Utah

magnet comes from the Wasatch Mountains in Utah.

Lodestone led to the invention of the magnetic compass by the Chinese in the 12th Century. It is one variety of the mineral magnetite which has the property of attracting iron and other metals. A steel needle placed in contact with a lodestone will in a short while become so magnetized that, if free to move, it will point toward the north pole. It was observance of this fact that suggested the compass.

The attraction of the lodestone for iron was known hundreds of years before the polarity of the mineral was discovered, according to Dr. Oliver C. Farrington, curator of geology at the museum.

"Thales of Miletus (630-550 B.C.) mentions this power of lodestone as do a number of the later Grecian sages," states Dr. Farrington. "There is a fable that the discovery of the lodestone was made by a Cretan shepherd who noticed that his iron-pegged sandals and iron-shod crook clung to the earth. Digging into the ground he found lodestone.

"In classical times and during the middle ages, extravagant tales based upon a misconception of the power of lodestone were current. There were stories of magnetic domes which held statues of iron and even of brass suspended in the air, and there were accounts of mountains of lodestones which drew all the iron nails from ships which ventured near them, so that vessels sailing those seas were obliged to use wooden pegs for nails.

"Discovery of the compass has been attributed to many peoples of Europe and Asia. Many accounts of the early use of the compass are now believed to be mythical. One of these credits the Chinese emperor Hoan-ti with constructing in the year 2637 B.C. a chariot on which was a female figure which always pointed south, and there are other Chinese accounts of the use of these 'chariots of the south' at various times antedating the Christian era. Some European authors seem to indicate an occasional use of the compass as early as the 3rd Century but the first authentic records of its use do not antedate the 12th Century. Shortly after this time the compass came into general use by mariners. The first compasses were magnetized steel needles which were fastened to chips and reeds and floated on water."

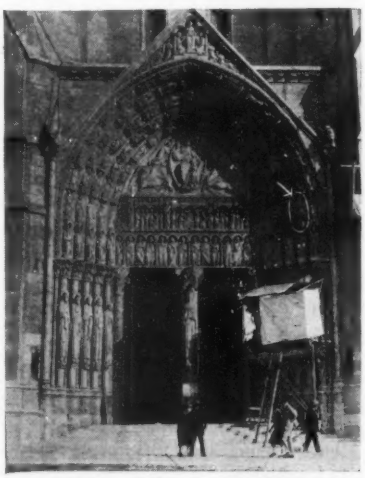
THE CHEMISTRY OF RIPE OLIVES

WE have often heard that one has to cultivate a taste for olives, but while we readily confess to a weakness for the more common green olive, we have never been able to get up much enthusiasm for the ripe, or purple, variety. A possible explanation for this prejudice came to our attention recently in reading an article in *Industrial and Engineering Chemistry* by James G. Vail, vice-president of the Philadelphia Quartz Company. Mr. Vail informs us that ripe olives are treated in a solution of caustic soda before they are considered fit to eat. Now, any chemist can tell you that when you treat olive oil with caustic soda you get castile soap. With that fact in mind, it suddenly dawned on us why we never cared for ripe olives.

Actually, of course, if any soap is produced by this caustic treatment it is only in infinitesimal amounts. The subject is of interest, however, because Mr. Vail has discovered that a sodium silicate solution, which will not saponify the oil of the olives, seems to serve just as well as the customary caustic soda. Indeed, by using silicate solution, the olives may be allowed to ripen further on the tree and still yield a firm texture. The flavor of the fruit treated by the new process is said to be better. —*A. E. B.*

EINSTEIN, LIVING IMMORTAL

NOT that Einstein "needs the publicity"; or that the fact that most men of science regard him as the greatest scientist, fit to rank with Newton, really requires constant reiteration; but because the editors from time to time receive communications from persons who either request confirmation of his high standing in science or, as sometimes occurs, wish to have their private opinion confirmed that he is a "faker" (as one rather excitable anti-Einsteinian repeatedly put it), attention is called to the recent tribute of the Riverside Church in New York which has chosen to include a carved figure of Einstein with those of the world's very greatest on the tympanum of the doorway of its new edifice.



A white oval has been marked on this illustration to show the location of the carved statue of Dr. Einstein over the main portal of the Riverside Church, New York City

Einstein is the only living person thus to be honored. The action of this church brackets his name with those of Socrates, Plato, Aristotle, Descartes, Spinoza, and Kant, the philosophers; Moses, Buddha, Saint Francis of Assisi, Luther, and Calvin, the religious leaders; and Galileo, Kepler, Newton, Faraday, Darwin, and Pasteur, the greatest scientists of all time.

The vast majority of men of science will concur in this selection. We believe that the statement of the physicist Heyl, that the majority of men of science qualified to judge—the physicists and astrophysicists—tentatively accept the Einstein Theory, will bear up under unbiased investigation.

Perhaps the fact that the newspapers have "made so much of" Einstein has tended to confuse some of the people. Certainly, at any rate, there is enough precedent—newspapers taking charlatans seriously—to make this kind of judgment seem plausible. But in this case the newspapers are right. Whoever permits himself to believe that Einstein is not looked up to by men of science should stop taking seriously the vitriolic phrases of a few superheated anti-Einstein cranks and should go among men of science where they are likely to obtain a new orientation.

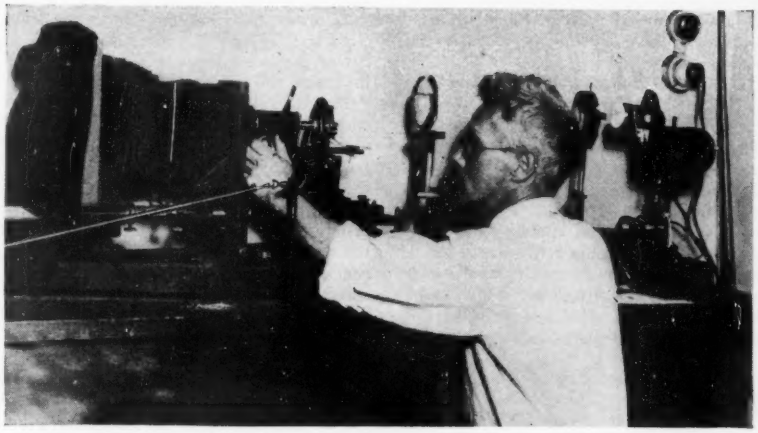
Another naïve question sometimes is asked: "Is Einstein really Jewish?" Einstein is a Jew.

EXPERT FINDS WAY TO PHOTOGRAPH SMALLEST LIFE

THE tedious work on the part of artists in illustrating minute forms of animal and plant life which can only be seen through a microscope, has finally been overcome by J. G. Pratt, scientific photographer for the United States Department of Agriculture.

Heretofore biological subjects could only be photographed satisfactorily from 10 to 15 times their natural size, which was not sufficient, and such subjects have always been drawn by artists, requiring hours of labor looking through a microscope, with little assurance that the resulting illustration was true to nature.

The difficulties encountered in photography at high magnification have been the flatness of field and the lack of proper illumination. Above 10 or 15 diameters the exposures are so long as to be impractical, and the short focus lenses required do not give sufficient depth of focus. That is, if a tiny insect were magnified sufficiently to see what it looks like, only a portion of its back would be sharply defined, the rest being hazy and distorted.



Mr. Pratt at work on his new equipment for photographing small life

After years of research Mr. Pratt has just developed a lighting device which is many hundreds of times stronger than sunlight, and also lenses which give great depth of focus, making possible the photography of animal and plant subjects up to as high as 300 diameters.

Mr. Pratt states that photo-micrography at such extreme magnification has heretofore been confined to metallurgy, on subjects which are flat and reflect a great amount of light; and that the new development should revolutionize the illustrating of biological subjects, which have considerable depth and reflect little or no light. He says that where previously the exposures for a magnification of 10 diameters took several minutes, only a few seconds are required for as much as 200 diameters with the present lighting device.

ULTRA-VIOLET TRANSMITTING GLASSES

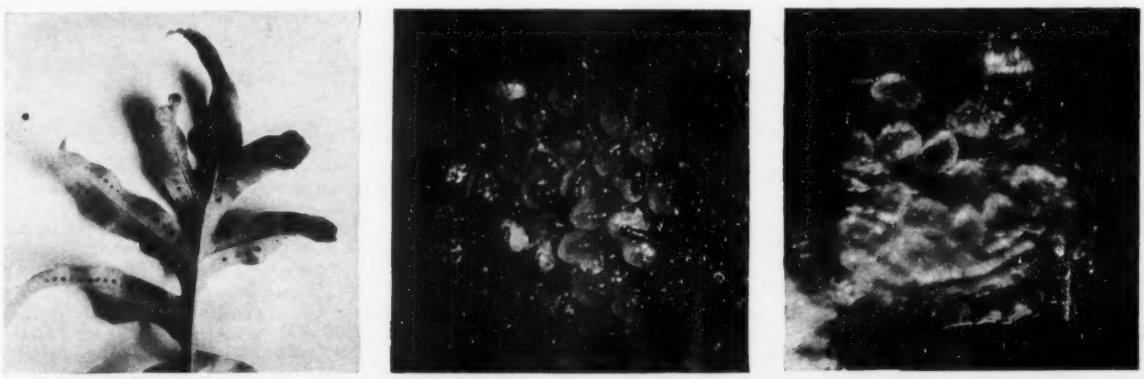
THE Council on Physical Therapy of the American Medical Association has made available a study of the value of glass of various types for transmitting ultra-violet rays. Dr. W. W. Coblenz of the Bureau of Standards in Washington, who is a member of the Council, points out again that ordinary window glass cuts off the ultra-violet rays, transmitting only 1 to 2 percent and being completely opaque to radiation of the shorter wavelengths. The maximum value of ultra-violet rays appears to be in the wavelengths from 297 to 302 millimicrons. Only a weak effect, if any, is obtained with longer wavelengths.

So far as the prevention of rickets is concerned, only window glass which has a transmission of 30 percent or higher of wavelengths of 302 millimicrons will give protection. It is understood also that the amount of ultra-violet received from ordinary sunlight is modified by altitude, latitude, time of day, the season of the year, and the amount of smoke. Obviously therefore only glass that will transmit ultra-violet freely is of any use. In the ordinary home it is perhaps better to do without window glass altogether for the room in which the child is to be sunned, and to use instead some sort of substitute.

The various devices for producing ultra-violet rays have been standardized by the Council on Physical Therapy of the American Medical Association, and inquiries concerning any special variety of lamp are answered with statements as to actual virtues in providing ultra-violet.—*M. F.*

CHILDISH DRAWINGS ON WALL OF ROMAN HOUSE

ONE family of ancient Rome would no doubt be greatly entertained if it could see archeologists of 1930 poring over the scrawled drawings made on the walls of their house. The drawings, recently discovered, are such as children of ancient



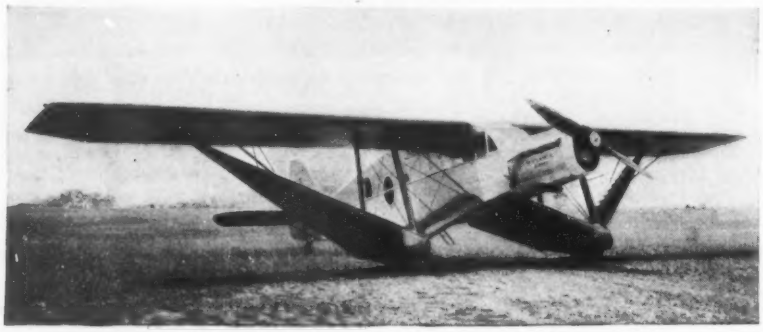
At the left is shown the frond of a fern with its fruit dots or spore clusters. In the center is a single fruit dot magnified 30 times. The small band resembling a worm on each spore case is known as the annulus. At the right: single spore case magnified 200 times, as the annulus is contracting and scattering the spores. All were photographed by Mr. Pratt

Rome, or any other time and place, enjoy scribbling on a handy piece of clean wall space.

The house of these wall decorations stood in the famous Appian Way about the time the Roman Republic became the Empire of Rome. Its ruins have lain buried beneath almost 40 feet of earth, and a Church of San Sebastian stands over the site.

Prof. Francesco Fornari, Roman archeologist who has been studying the mural sketches, sees in some of them pictures of fighting gladiators armed with shields, spears, and swords. Another sketch is believed to show an individual being burned. Rows of long and short lines, rising before this person, indicate flames, and there are soldier-like figures on each side who appear to be stirring up the flames with their spears. It is considered likely that the drawings were made by the children of some Roman fighter's household.

Other parts of the walls are adorned with frescoes done by more professional hands. —*Science Service.*



The Bellanca *Airbus* has a novel system of wing trussing

THE BELLANCA "AIRBUS"

G. BELLANCA of the Bellanca Aircraft Corporation is a designer who can be relied upon to produce original and worth-while modifications from standard practice.

For the designer of transport airplanes, there are two outstanding problems at the moment. One is to give the operator a greater payload for a given horsepower, thus making operations more economical—but without reducing speeds. The other is to provide him with a craft which will enable him to take full advantage of the Watres Bill, under which the Postmaster General can hire space in passenger-carrying planes, and which, therefore, necessitates the construction of planes to carry both mail and passengers.

The Bellanca *Airbus* certainly appears to meet these requirements by excellency and originality of design.

The main wing, mounted on top of the cabin, is similar to that of a conventional braced-wing monoplane with the exception that each wing is divided into two panels. The inner or center section panels of the upper wing, in conjunction with the lower stub wings, form the inner bay and are joined together by struts of round, chrome-molybdenum steel tubing, faired with balsa wood. From the outer end of each stub wing another lifting surface called the auxiliary wing goes up to meet the outer panel of the upper wing.

What is remarkable in this system of wing construction is that both the stub wing and the auxiliary wings serve a number of purposes. The auxiliary wing serves to brace the upper wing like ordinary struts, but also provides lift. The lower stub wings are even more useful. They provide lift, form conveniently a part of the landing gear structure, and also contain the waterproof metal-lined mail compartments which have a capacity of approximately 60 cubic feet, and which, placed in the stubs, do not encroach on the passenger compartment. The advantages of this peculiar wing system are obvious. The auxiliary wings do not just introduce air resistance when performing their bracing function; they lift and carry load. The stubs carry load, yet they give ideal support to the landing gear. There is a general gain in efficiency.

The landing gear of the *Airbus* also represents a departure from conventional practice. The wheels go into recesses at those ends of the stub wings where the auxiliary wings join. The wheels are cushioned and kept in their proper position by oleo struts; the struts are attached to beams running from front to rear of the landing gear recesses. The wheels disappear almost completely into the stubs, yet at the same time they are well below the fuselage of the plane. This type of landing gear, therefore, attains many of the advantages of the retractable landing gear without its mechanical complication.

The control system introduces a wrinkle, not new perhaps, but interesting. Each aileron is separately connected to the control wheel, so that if one aileron becomes inoperative, there is the other to count upon.

In the passenger cabin, there is another minor yet useful idea. The passenger seats on each side of the cabin are on a platform 12 inches high. This leaves a sunken aisle down the middle, permitting a tall man to stand erect. The baggage is conveniently stored beneath the platforms on which the seats rest.

With a Curtiss Conqueror 600 horsepower engine, with 4000 to 4500 useful load —say 10 passengers, 250 pounds of baggage, some 1000 pounds of mail, and 200 gallons of gas—the high speed is 147 miles per hour, the cruising speed 125 miles per hour.—*A. K.*

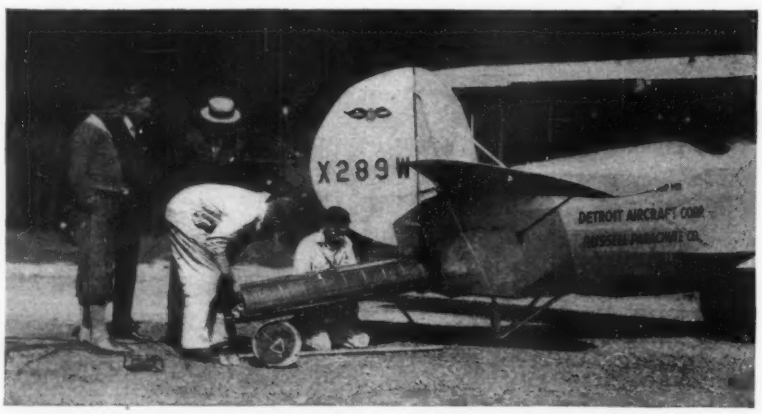
AN AIRPLANE PARACHUTE

MUCH thought and effort have been expended on the design and use of parachutes for passenger service. Recently we described in these columns a quickly-detachable and attachable parachute for passenger use. There always remains the question, no matter how easy the use of the parachute may be made for the passenger, of whether the average passenger will have the presence of mind to avail himself of this device or whether he will pull the rip cord neither too early nor too late. Many authorities are of the opinion that the better plan is to provide a parachute for the entire plane. The Russell Parachute Company has developed such a "ship parachute," as it is frequently called, and, with the co-operation of the Detroit Aircraft Corporation, has recently tested out the apparatus on a Parks two-seater biplane of about 1800 pounds gross weight.

Aviation describes the apparatus in somewhat greater detail than the reports of the Russell Parachute Company itself:

"Except for a control lever in the cockpit, four suspension cables attached to the plane's center section, and, of course, the control lever cable, the entire device is enclosed in a metal tube, made scarcely noticeable by being faired into the bottom of the fuselage. The tube is about 11 inches in diameter and extends from a point directly below the center section to a point below the rudder hinge line.

"The 'chute, 60 feet in diameter, is folded inside a metal container, or 'split can' located all the way forward in the tube. The 'can,' which is round, has an inch clearance between it and the inside wall of the tube. Runners inside the tube hold



Loading the airplane parachute in the tail of the fuselage. The pilot 'chute which is contained in the cup pulls the large 60-foot 'chute from the cylinder

the 'can' in exact center. The four suspension cables extending from the lower shroud lines of the 'chute to the plane's center section are run out of the forward end of the can, through guides located between the can and the inside walls of the tube to a streamlined cap on the after end of the tube. They then extend through an opening in the cap, thence to guides located near the top of the rudder post, after which they are carried to the plane's center section by means of additional guides on the back of the fuselage. Between the streamlined cap and guide atop the rudder post, two cables extend along the two sides of the fuselage to prevent the parachute cables fouling on the tail surfaces.

"The pilot's control cables extend directly from the cockpit to the cone-shaped cap which is attached to an 18-foot pilot or 'drag' 'chute. Operation of the device is as follows: When the pilot lifts his lever in the cockpit, the cone-shaped cap flies off the tube, releasing the drag 'chute. By means of the drag cable, the small 'chute pulls the split can containing the large parachute out of the tube. Upon being released from the tube the split can opens and releases the large 'chute, which pulls the cables from their guides, thereby suspending the plane from its center section by means of the four suspension cables."

The whole apparatus weighs only 100 pounds, and it is claimed that it will right the airplane from any difficult position and bring it down at a speed of 16 feet a second, which will mean a rough but perfectly safe landing.

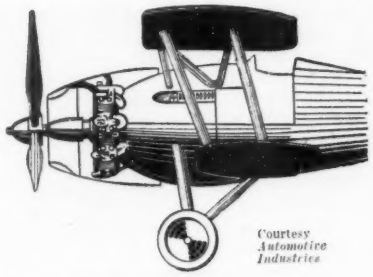
On the first test, the Parks biplane landed in a tree under conditions approximating those that would be encountered during emergency use. The only damage sustained was a broken propeller and a bent axle.

Further tests will be awaited with interest.—*A. K.*

COWLING-IN THE RADIAL ENGINE

THE great objection to the radial air-cooled engine is that the projecting cylinders not only have large resistance themselves, but that they also break up the streamline flow over the fuselage and thereby introduce still more "parasite" resistance.

A. H. R. Fedden in a paper before the Institution of Mechanical Engineers (of England) visualizes a completely cowled-in radial engine, shown diagramatically in the accompanying sketch. The cowling is of



Courtesy *Automotive Industries*

Fedden's conception of a cowled-in, radial, air-cooled engine to correct objectionable features of this type

streamlined form itself, and blends with the streamline design of the rest of the fuselage. The propeller is of necessity mounted on a shaft extending somewhat farther from the engine than in the conventional type of engine. Through a circular hole at the front end of the cowling only enough air is admitted to cool the motor. The cooling air then passes through a circumferential gap, behind the engine, and at exit combines, with minimum disturbance, with the main flow around the fuselage.

Certainly such cowling-in should be decidedly beneficial to the over-all performance of the airplane, and we do not see that it offers any insuperable difficulties of a mechanical character.—*A. K.*

FLEXIBLE-WING PLANE

WE append two photographs of the Waterman "fool-proof" plane built in Los Angeles. The complete technical details are not yet available, but the principles of the invention will be deduced from our photographs.

The outer portion of the wings is not rigidly connected to the airplane. It is rather hinged about the wing stubs adjoining the fuselage and controlled by the action of the two struts which can slide in and out of the hydraulic cylinder mounted on each side of the fuselage. By means of this hydraulic adjustment, the dihedral, or V, of the wings can be changed at will and therefore the lateral stability of the plane can be varied to suit flying conditions or the pilot's preference.

We believe, but we are not quite sure, that when the V is increased, the angle of incidence of the outer portion of the wing is somewhat increased. This means that the wings can be set at the angle most appropriate for high speed, for cruising, or for climbing.

The movement of the piston in the cylinder is controlled by the pilot, but the wings are also slightly automatic in action and therefore respond to gusts striking the airplane. If the wind gust is such as to tend to raise the left wing, then the left wing will yield, thereby decreasing the effect of the gust. If the gust strikes both portions of the wings from below, both wings will yield and the load will be relieved. This might tend to make flying in "bumpy" weather slightly more comfortable. That it will add to the structural strength is doubtful.

When flying, even in rough weather, the loads due to gusts are small in comparison with the loads which the pilot can impose himself in landing the plane; and raising the outer portion of the wings lowers the machine considerably relative to the ground. This brings into play a huge skid at the front end of the machine. The skid grazing the ground acts as a powerful brake and as the center of gravity has been loaded there is no tendency for the plane to turn over on its nose.

Against these theoretical advantages are to be set the complications of the device. Complete theoretical and practical investigation of the device would be necessary before its value could be determined. But Mr. Waterman has flown his craft safely across the continent and back and that is worth considering.—*A. K.*

At right: **The Waterman "fool-proof" plane in which the wings yield against the restraint of hydraulic cylinders to give less "bumpiness" in gusty weather.** ***Below:*** **The same plane with its wings raised**

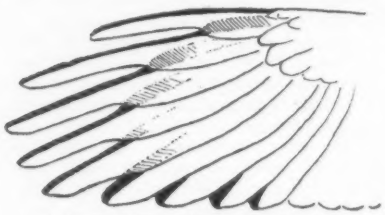
SAFETY DEVICES IN BIRDS' WINGS

BIRDS are the result of the survival of the fittest through countless ages of flying; we have been flying for only some 27 years. Perhaps we have yet to learn many flying secrets from them. Lieutenant R. R. Graham, writing in a recent issue of *British Birds*, certainly makes a strong case for the possibility of such lessons. (Another exposition on the same subject appeared on page 386, November 1930, *Scientific American*. Editor.)

Nature has provided birds of many species with separating flight feathers. A notable example is the wing of the buzzard, seen from below in one of the appended sketches.

The separating flight feathers of the buzzard present what the ornithologists call "emargination." The separating feather is reduced in width from a broad base to a much narrower tip. The result of this ar-

rangement is that when the wing is fully spread, the outer parts of the feathers do not overlap, and gaps or "slots" form between them as is apparent in the same sketch. The feathers radiate or spread out from a fairly small center. Without this emargination the slots would be narrow at



Above: **The under surface of the right wing tip of a buzzard.** *Below:* **The lower surface of a song-thrush's right wing-tip, with the slots more than fully opened. Gaps appear beyond inner limits of slots**

the base. With emargination the slots are of a fair width, even at their inner extremities.

The feathers are worth a little further study. In the flight feathers of a partridge not only is there some degree of emargination; there is also more width of web behind than in front of the shaft. In aerodynamical parlance the center of pressure of the feathers is behind the shaft.

The result of this "construction" is that when the flight feathers open, they twist upwards at the rear edge (a fact fully confirmed by actual photographs). The flight feathers then offer a series of fair slots, *with the incidence of the flight feathers smaller than the incidence of the main wing.*

Surely the flight feathers are in close analogy to the Handley Page multi-slot.

When the bird wishes to descend steeply, he sets his main wing to a large angle with the wind. The main wing is "stalled," loses lift, and acts as a brake. The slotted tips are not stalled and still give lift, and hence there is also lateral control still available. In other words the bird is an airplane or glider which can make a steep, stalled descent, with perfect control.

Of course, as Lieutenant Graham points out, the bird has one point of superiority which is difficult for us to imitate. If the stalled descent is too rapid in a vertical direction, there is danger that the bird will strike ground or water too rapidly. He then flaps his wing back and forth and secures lift by a few strokes just before alighting. A mechanical embodiment of this practically horizontal movement of the flight feathers would be very difficult for us to secure.

Among other wonders of bird "construction" described is a very interesting safety device. A bird's wing tip, with feathers loose from one another, can be drawn so far apart in our hands that gaps appear beyond the inner limits of the slots and barbs are torn apart from each other. This is the case for the song-thrush's wing tip. But when an effort is made to spread the feathers while pressed together, it is found that they will open thus far and no farther. Examination of the feather surfaces with a microscope indicates that the effect is brought about by thousands of tiny hooks which stand out above the main surfaces and engage with the ribbed under surface of the broad part of the overlapping feather.

This is certainly a complete vindication of the value of the Handley Page slot, if the birds are to be credited with knowing something about flying!

MAJOR WILLIAM C. OCKER

WE are very pleased to announce that, after proof of the article "Instrument Flying to Combat Fog," on page 430, had been finally okayed, we received word that its author, William C. Ocker, had been promoted from the grade of Captain to that of Major, Air Corps, United States Army. It was too late to make this change under his name in the byline of the article.

Major Ocker's promotion indicates a rendering of recognition for his splendid ability by the Chief of the Air Corps and therefore gives to his article an even greater authoritativeness, if that is possible.

99.99 PERCENT PURE ZINC

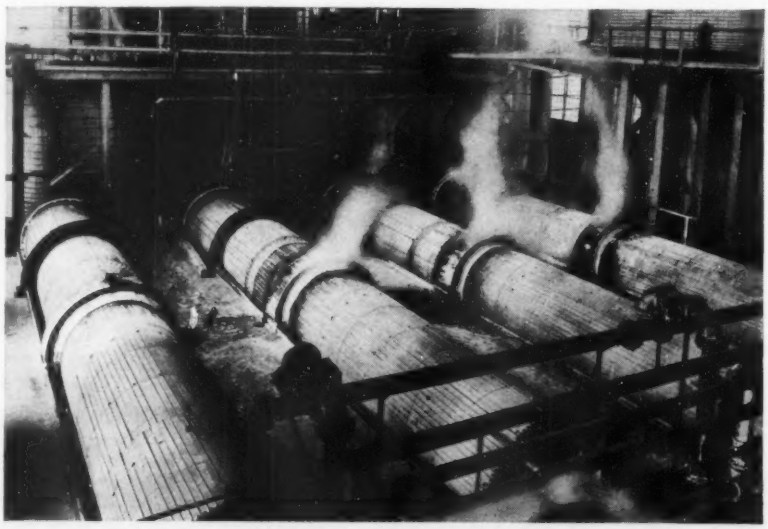
ELECTRO-CHEMISTS of the Evans-Wallower Zinc Company in St. Louis have exceeded the famous record of a well-known soap, advertised as 99.44 percent pure, by developing a process for the production of zinc which is actually 99.99 percent pure. The process is an electrolytic one—the zinc being extracted by dissolving the ore in acid and electrolyzing the resulting solution to extract the pure zinc. Metal of this purity has remarkable properties, being very ductile and possessing high tensile strength. At 350 degrees Centigrade it can be extruded quite readily and drawn into wire.

The process used in this new plant is described by Charles W. Cuno in a recent issue of *Industrial and Engineering Chemistry*. The zinc ore, known as concentrate, contains zinc sulfide and small amounts of cadmium, copper, and iron. The ore is first dried and roasted and then passed through magnetic separators which divide the material into two parts—one high in iron content and the other very low in iron content. The magnetic material which contains the more insoluble zinc is treated with dilute sulfuric acid, in specially designed leaching tanks. The ore is tumbled around in these leachers until the insoluble zinc compounds have been decomposed, after which the non-magnetic portion of the ore is added. During the first stage of the leaching operation, the iron dissolves and is later precipitated as the charge neutralizes the acid. When the leaching operation is complete, the solution and residue are filtered, thus removing the insoluble residue of iron, silica, lead, gold, and silver. The residue is dried and shipped to a lead smelter for the recovery of its metal values.—*A. E. B.*

SOUTH CAROLINA VEGETABLES

THE state of South Carolina is taking seriously the question of the mineral content of its vegetables. A foundation has been established with a research laboratory and enough evidence has already been accumulated to arouse propaganda for California packers to move to South Carolina. The California fruit growers have emphasized the importance of California oranges as a source of vitamin C. The South Carolina Food Research Laboratory counters with a comparative statement showing that California oranges provide 70.5 parts per million of iron as contrasted with 160 parts per million in South Carolina tomatoes; they contain 7.6 parts per million of manganese as contrasted with 26.7 parts per million in South Carolina tomatoes and the oranges contain 4.75 parts per million of copper with 15.3 in tomatoes. Little has been claimed for California oranges so far as concerns their iodine content, but the South Carolina tomatoes contain 166.5 parts per million of this valuable mineral.

The South Carolina authorities, led by Dr. William Weston, recommend South Carolina tomato juice as superior to California orange juice for the growing infant. In their experiments on the feeding of infants, the South Carolina Food Research Laboratory has emphasized particularly



The leaching tanks used in the electrolytic zinc process

heroes must not lisp!

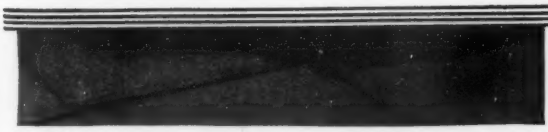
"My thweet" lisped from the screen would mar the star's romantic appeal. But that is something you don't hear in the theatres which have Western Electric talking picture equipment.

To reproduce the letter 'S' was but one of many difficulties in the way of giving you talking pictures at their best. Western Electric was able to solve these problems by reason of its 50 years' experience in making Bell telephones and other voice transmission apparatus.

All over this country, and indeed the world, a discriminating public flocks to Western Electric equipped theatres—one more proof of this company's leadership in *sound.*

Western Electric

Makers of your Bell Telephone and leaders in the development of Sound Transmission



THE WESTERN ELECTRIC SOUND SYSTEM GIVES YOU TALKING PICTURES AT THEIR BEST IN OVER 6,500 THEATRES

the value of carrot top and lettuce concentrates. These seem to be especially valuable as a source of iodine, manganese, iron, and copper.

The relationship of manganese, copper, and iron to anemia has already been emphasized in many publications. Much has been written of the value of liver in control of anemia. The South Carolina authorities urge oysters as of interest in this connection.—*M. F.*

TRANSPACIFIC SPEED RECORD

A THIRD record was shattered when the Canadian Pacific liner *Empress of Japan*, completing her first voyage from Japan to Canada, docked from Vancouver, Victoria, and Honolulu at Yokohama recently. The elapsed time for the trip from Honolulu to Yokohama was 6 days, 19 hours, 43 minutes, or about 20 hours faster than the previous record held by the N.Y.K. liner *Chichibu Maru*.

During her Pacific lifetime of only a few months, the new Canadian Pacific liner has broken the record for each leg of the voyage.

IRON BASE FOR EXPERIMENTAL HIGHWAY

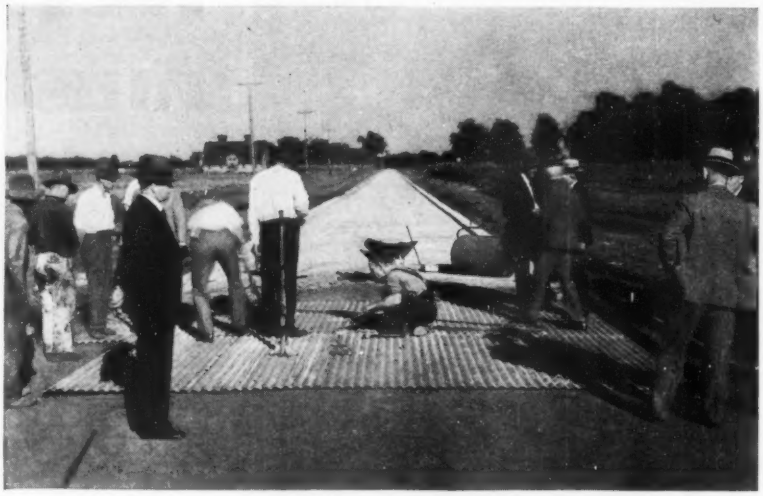
A CONTRACT for an experimental pavement with an iron base and curb has been placed for 150 feet of pavement, on the Grand Avenue Connection, near Springfield, Illinois, with the Rochester road, (State Highway, Sagamon county.) The roadway to be laid this month will be the first test of three different designs. The iron base and curb will be laid on a levelled highway, says a report which discusses the design of this highway, which may revolutionize the building of roadways.

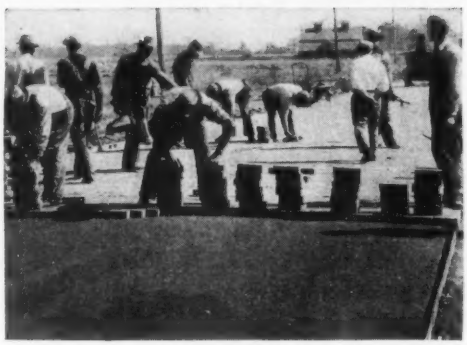
As explained by the engineers, the road will have a carefully rolled and prepared sub-grade on which the iron base and curb will be laid. Next will follow a mastic sand cushion upon which will be placed a layer of two and one half inch or three inch brick with asphaltic filler poured into the interstices between the bricks. The result, it is declared, will be an indestructible base with a smooth riding surface built into the structure with sufficient flexibility to meet temperature changes without breaks or cracks.

The iron base will consist of three 50-foot sections. One will be blue annealed flat sheets and the other two galvanized and corrugated sheets. The corrugations in one 50-foot section will be parallel to the road and in the other they will be transverse. The flat iron base will be ¼ inch thick, and the corrugated galvanized will be 10 gage.

The three types mentioned above will be tested under actual conditions. If they prove successful under traffic conditions, great progress will have been made in highway construction, is the belief of engineers. Such a roadway will not only be flexible, but should eliminate cracking and permanent deformation. The use of rust-resisting materials will insure durability. The iron base is Armco Ingot Iron and will be rolled and fabricated by The American Rolling Mill Company and the brick will be furnished by the Poston-Springfield Brick Company, of Springfield, Illinois. The National Paving Brick Manufacturers Association is co-operating in the test.

Mr. Mosely, the originator of the idea, recognizes that the success of the new metal highway depends to a large extent on the longevity of the metal used.





The blue annealed sheet-iron section of the base for the new experimental iron base highway. The middle cut shows the section where corrugated iron was used as the base, corrugations running parallel to the road. *At bottom:* Brick surface was laid according to regular practice. The road was finished after the accompanying article was written

CRYSTALLINE RUBBER CLEAR AS GLASS

CRUDE and refined rubber are known to consist principally of hydrocarbons. These hydrocarbons are mixed with smaller quantities of various impurities which can be removed only by a series of long and tedious operations. The highly purified rubber resulting from these operations is a clear, colorless, transparent, elastic solid, as clear and colorless, in fact, as the best plate glass. The problem of ascertaining the composition of this highly purified rubber has heretofore been exceedingly difficult because of the fact that two of the most useful processes ordinarily employed by the chemist—crystallization and distillation—could not be applied to the material.

A process has recently been developed at the United States Bureau of Standards by which this pure rubber can be repeatedly crystallized, thus opening the possibility of successfully fractionating it into its constituent hydrocarbons and eventually of determining the formulas of their molecules. The crystalline rubber obtained by this process, as seen under the microscope,

Actual PUMP INSPECTION *Safeguards* ETHYL quality

Ethyl inspector purchasing actual sample of Ethyl Gasoline *from the pump*. In Ethyl laboratories this sample must meet all Ethyl requirements.

MAYBE you've seen these inspectors, driving cars like this, stopping at Ethyl pumps, buying a gallon here and a gallon there. They are Ethyl representatives—making sure that all gasoline sold under the Ethyl emblem has the full extra quality of Ethyl Gasoline.

Each one of these cans is sealed and marked at the filling station and sent to Ethyl laboratories for testing.

The 76 oil refining companies that mix Ethyl fluid with their gasoline cooperate by authorizing these tests so all Ethyl Gasoline will meet the standard you have learned to expect.

Before any gasoline is mixed with Ethyl fluid at the refineries, a sample is sent to an Ethyl laboratory. A test shows how much Ethyl fluid is needed to bring it up to the standard of Ethyl Gasoline. At least this much Ethyl fluid is then added. After the mixing, a sample of the finished Ethyl Gasoline is sent for testing.

But even this is not enough. To make sure Ethyl Gasoline reaches you with quality unchanged, inspectors take samples from Ethyl pumps throughout the country.

So you are triply protected when you buy at the pump that bears the Ethyl emblem. Its standard of quality is never lowered. Ethyl Gasoline Corporation, Chrysler Building, New York City.

WITH ETHYL BRAND OF ANTI-KNOCK COMPOUND ETHYL GASOLINE CORPORATION NEW YORK, U.S.A. Knocks out that knock

Wherever you drive—whatever the oil company's name or brand associated with it—*any* pump bearing the Ethyl emblem represents quality gasoline of high anti-knock rating.

The active ingredient used in Ethyl fluid is lead

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ETHYL GASOLINE

Ice in the ship channel of a river "rotted" away and a clear channel being made with calcium chloride

consists of small transparent plates. As the crystallization process continues, these plates agglomerate into larger and larger clusters. The crystallization process is carried out by cooling a dilute solution of the highly purified rubber dissolved in ether to a temperature of about –80 degrees Centigrade.—*A. E. B.*

DESTROYING CHANNEL ICE

LAST winter a steamer loaded with valuable cargo was imprisoned in the ice of Lake La Barge near the headwaters of the Yukon River. With buckets and brooms the crew swabbed a strip, 29 miles long and 40 feet wide, of lamp-black and thinned refuse oil across the ice. And because black absorbs the sun's rays and retains heat, this strip in the course of a month cut a channel a foot deep as evenly as though it had been sawed. It continued to deepen and widen so that the boat was released from the ice one month ahead of its usual time.

At Morrisburg, Ontario, a steam ferry operated all last winter on schedule through a channel kept open with the aid of calcium chloride.

Here are typical examples of the results obtained by Dr. Howard T. Barnes, of McGill University, who is acknowledged as the world's leading exponent of the new science of ice engineering. He has discovered that calcium carbide, calcium chloride, sodium chloride, charcoal, lamp-black, and cinders will "speed up" the spring thaw of river, lake, and harbor by as much as one month. These materials "rot" and destroy surface ice in the most frigid temperatures, leaving it weakened to such an extent that when the sun swings northward in the spring, the ice melts quickly along these lines of least resistance and passes down stream in small cakes. By spreading these chemicals in a definite pattern over the ice with the aid of an ordinary road-spreader, young ice has been destroyed in a few minutes and channels kept open in proportion to the economic desirability of such work.

Dr. Barnes has also developed two very powerful weapons against icebergs and ice jams. One of these is thermit, which was first described in the press several years ago. Placed in shallow holes dug in the ice at strategic points, it is touched off either with a fuse or a small charge of flashlight powder. The iron oxide and aluminum powder, of which it is composed, instantly react by producing a temperature of 5000 degrees while streams of molten steel are shot through the ice in all directions. The surrounding ice is literally decomposed into its constituent elements of hydrogen and oxygen, the former being released as a flaming gas which often flares a hundred or more feet into the air.

By this means Dr. Barnes destroyed an immense ice jam in the St. Lawrence River which weighed more than 1,000,000 tons, only two 90-pound charges being employed. On another occasion he vanquished an iceberg which measured 500 feet at the water line with a single charge of 100 pounds.

Last winter the ice engineer perfected a new weapon called solite. It is equally as powerful as thermit, but needs neither fuse nor battery to touch it off. Loaded into bombs it can be dropped on otherwise inaccessible icebergs from speeding planes with no risk to the operator. The bombs are open at the top, and as they rush through broken ice a partial vacuum is formed in the hole which prevents the water from entering. When the bomb finally comes to rest the water rushes into the hole and automatically ignites the charge. Experiments conducted on the St. Lawrence River last winter and by the International Ice Patrol off the coast of Labrador last spring prove that solite is eminently successful in destroying both ice jams and icebergs.

BUTYL ALCOHOL FROM POTATO PULP

WASTE pulp from potato-flour factories will be used as a raw material for the bacteriological production of butyl alcohol and acetone by a process developed at the Dutch agricultural experiment station at Gronigen, according to a report from the commercial attaché at The Hague. The process is said to overcome the difficulties caused by the varying composition of the pulp and its usually strongly soured condition. Millions of pounds of pulp are available annually, and production using this patented process will be begun as soon as possible.—*A. E. B.*

THE STING OF THE HONEY BEE

THE sting of the honey bee is seldom considered to be of much importance, except when an entire swarm attacks a man; then he is likely to suffer greatly from manifestations of his disturbance. When a person is stung by a bee it is customary usually to apply solution of ammonia or of baking soda to the skin. Ordinarily this is sufficient to modify the local irritation, and little more is thought of the trouble.

Some studies recently completed in the Mayo Foundation indicate that the venom of the honey bee resembles that of the rattlesnake in several particulars. Both poisons when in contact with the blood break down the red blood cells; both poisons when injected into the arm promptly stop its action. Bee-sting poison is a stimulant of smooth muscle, such as is found in the heart and in the uterus and is a dangerous poison to the lining of the blood vessels. Obviously it is a potent substance and if taken into the body in sufficient quantity can produce death as can the venom of the rattlesnake.—*M. F.*

CAR SICKNESS

MANY people experience great discomfort when riding in trains or street cars. Many more become dizzy and uncomfortable in ships or airplanes. Physicians who have studied the subject are inclined to place the responsibility on the mechanism of the internal ear and on the eye. The tendency to car sickness seems to run in families. Dr. James E. Lebensohn points out that people most frequently disturbed usually avoid riding backward and favor the front seat of the automobile, where there is less jarring and where the view is less constricted. He points out also that when the land traveler gazes at the scenery, his eyes slowly follow the objects in the landscape which appear to be moving backward. As these objects pass out of the range of the vision, the eyes return to their normal position. Hence the eyes are constantly jerking, and this causes many to believe that the eyes are responsible for railroad sickness.

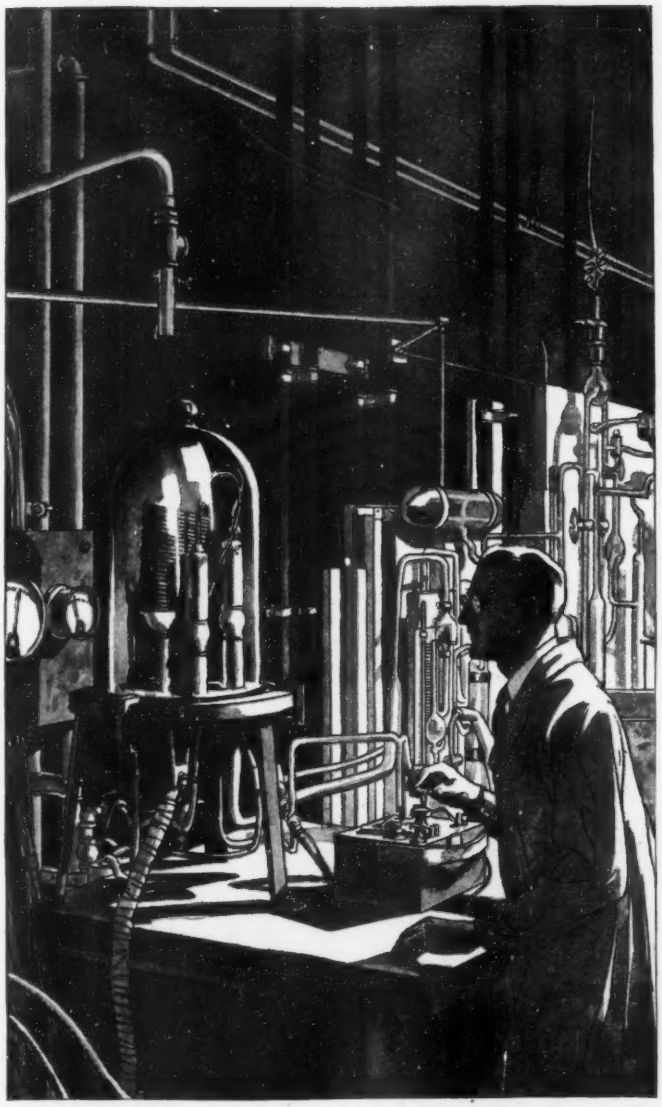
The chief symptoms of nausea are paleness, sweating, and goose flesh, most of these things being associated with nausea no matter how it is produced. In making a special study of the relationship of the eyes to car sickness, Doctor Lebensohn produced the jerking of the eyes that has been mentioned, known as optical nystagmus, and at the same time studied the

Destroying an ice jam with 12 pounds of solite, the new chemical which is "touched off" by water

changes that took place in the stomach. A cylinder marked in black and white was revolved before the patient's eyes to produce ocular nystagmus and cold water was thrown into the ear to produce labyrinth or internal ear nystagmus. At the same time the contractions of the empty stomach were measured by the movements of an instrument connected with a balloon swallowed and retained in the stomach.

ECONOMICS OF THE ELECTRICAL INDUSTRY

TOMORROW'S COST PROBLEMS...

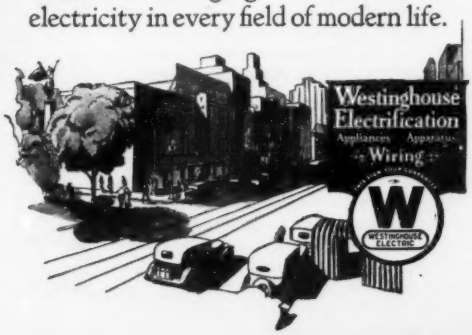


...in Today's LABORATORIES

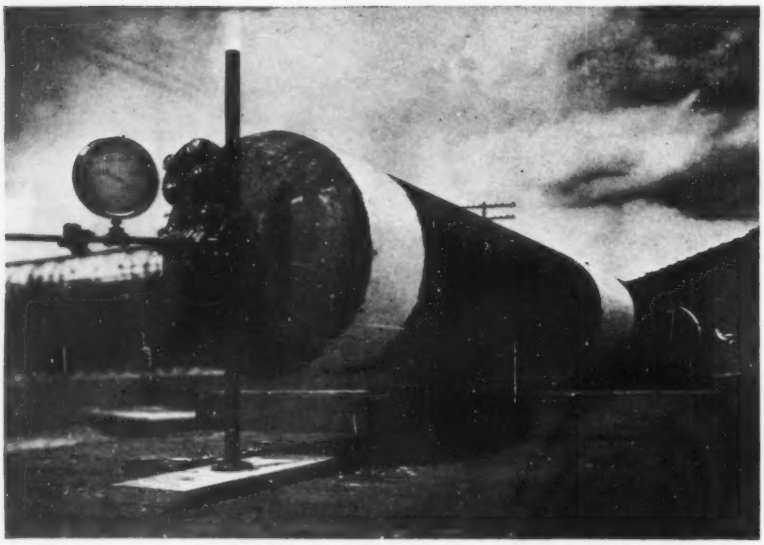
Modern science may well smile at the medieval alchemist, calling vainly upon the powers of darkness to aid him in transmuting base metal to gold. The workers in today's research laboratories call upon the powers of electricity — and secrets of far greater value are their almost daily reward.

It is impossible to estimate the vast increase to the world's wealth that electrical research has brought. In the Westinghouse laboratories at East Pittsburgh alone, discoveries valued well into the billions have been made. A cost-saving contribution to a single industry may be worth millions. A new metal to cut down transformer losses, a De-ion circuit breaker that eliminates oil quenching and consequent fire hazard, a marvelous "electric eye" that performs all manner of human tasks — and never forgets; these modern Westinghouse developments are part of the day's work typical of an organization devoted to enlarging the service of electricity in every field of modern life.

Tune in the Westinghouse Salute over WJZ and the coast-to-coast network, every Tuesday evening.



Westinghouse



Welded reaction chamber for a new synthetic process, being tested at the high pressure of 10,000 pounds per square inch without a sign of failure. The working pressure which this cylinder must withstand when in operation is 500 pounds

It was found that the effects on the eye produced little if any response in the stomach concerned with the maximum contractions associated with the production of labyrinth nystagmus. Hence Lebensohn is convinced that car sickness is due to the irritation of the mechanism in the internal ear, but he feels also that errors of refraction in the eyes and of muscle balance predispose a person to this malady. Such errors act as a depressant to the activity of the stomach and people with disturbances of vision are likely to have a lower resistance to nausea than those free from such disturbances.

The development of smoother roads and easier riding in automobiles is making car sickness less common. Dr. Lebensohn states that it is best not to go hungry when traveling, as an empty stomach is particularly sensitive to depressing influences. He recommends also that errors of refraction and of muscle imbalance should be corrected.—*M. F.*

HIGH PRESSURE TECHNOLOGY REQUIRES POWERFUL APPARATUS

PROBABLY the most lively topics of discussion among present-day chemical engineers are the several new processes in synthetic chemistry which utilize high pressures and high temperatures. By employing pressures and temperatures heretofore deemed impractical, the chemist has developed commercial processes for the fixation of atmospheric nitrogen, the hydrogenation of oil, and the synthesis of methyl alcohol. From the theoretical standpoint, there is nothing particularly new about these developments but it is only within the last few years that equipment suitable for the severe service required by the new technology has become available. New alloy steels of extremely high tensile strength and corrosion-resisting properties have been developed to meet the demands of high pressure technology. It has also been discovered that welded joints in steel pipes and tanks can be made sufficiently strong to withstand the severe conditions imposed.

What is said to be the most severe test to which a welded container has ever been subjected was performed recently on a welded tank by the A. O. Smith Corporation of Milwaukee, Wisconsin. One of our photographs shows the tank, which is 33 feet long, with 3½-inch walls, and an inside diameter of 26 inches, being subjected to a pressure of 10,000 pounds per square inch without any sign of failure.—*A. E. B.*

QUICK-FREEZING CANNED FRESH PEACHES

WHAT promises to be the first step in the establishment of an important new food industry has just been completed by Tom Huston of Columbus, Georgia, already widely known as "The Peanut King" and as an outstanding example of the South's younger generation of business leaders. While other organizations and individuals throughout the country have been experimenting, without notable success, in the application of the quick-freezing process to fresh fruits, Mr. Huston has organized Tom Huston Frozen Foods, Inc., built a 100,000-dollar plant at Montezuma, Georgia, the first of its kind in the world, and has completed a successful season of freezing fresh, tree-ripened Georgia peaches in commercial quantities.

Although for some years it has been a fairly common practice in the Pacific Northwest to freeze strawberries and a few other berries grown in that area, these products have been prepared for use chiefly by ice cream manufacturers, confectioners, and bakers. The Georgia plant represents the first step toward placing frozen fresh fruits on the market for family consumption, and for the entire year round. As such it is of outstanding importance to both consumer and grower, promising the former a new line of healthful and appetizing food products, and the latter a broader, more profitable, and better stabilized market.

Essentially, the process is the same as that which has recently been applied to the quick-freezing of fresh meats. By this method it is possible to imprison the original flavor in the fruit without that breaking down of the cells which accompanies ordinary freezing—a more difficult problem in the case of fruits than meats, since the cells are more delicate. The peaches are allowed to ripen on the trees. They are frozen within a few hours of reaching the plant, which is in the heart of the Georgia peach belt. Thus they have an opportunity to reach their full perfection of flavor, and no opportunity to lose any of it during transportation or while in storage.

Practically all of the fruit is brought from within a radius of about 15 miles of Montezuma. The fuzz and skin are first removed by a special process, after which a belt conveyor carries the peaches to tables where they are split in half, pitted, and carefully inspected. They are then run through slicing machines and down a belt conveyor to other tables where the slices are packed in quarter-pound containers, and a little sugar syrup is added. The containers are capped by machine and then pass through the freezing tunnels where the temperature is 35 degrees below zero. The entire process is completed under the most rigorously sanitary conditions.

The filled containers are kept in a cold

Georgia peaches, to be frozen in the cartons on the conveyor in front of the girl workers, have a sugar syrup added to them from the rubber hose overhead

Arctic clothing in Georgia! In the cold rooms where peaches are preserved by the quick-freezing method, the workmen have to be so clothed against the intense cold

room until ready for shipment. To maintain the necessary degree of cold, they are passed to the refrigerator cars through a portable, insulated tunnel. In the warehouse, hotel, restaurant, club, or drug store they are kept constantly at low temperature.

THE CONSTITUTION AND GASTRO-INTESTINAL DISEASE

IN the beginning of modern medicine, that is to say at the time when Hippocrates first introduced accurate observation as the basis of scientific study, attention was paid to the constitution of the human being and his structure in relationship to the disorders from which he might be likely to suffer. Indeed, the Greek teachers classified human types according to various characteristics. Persons of certain types, they asserted, were likely to suffer with certain diseases. The conception was favorably received and guided medicine until approximately the 13th Century, when the beginnings of modern research focused attention not so much on the human being as a whole as on individual tissues and structures and disorders. In more recent years it has come to be realized that medicine must be much more concerned with the human being as a whole. It is recognized that heredity and constitution are of vital importance in understanding the nature of man.

In his chairman's address before the section on diseases of the stomach and intestines at the last annual session of the American Medical Association in Detroit, Dr. Julius Friedenwald gave special attention to the human constitution in its relationship to gastro-intestinal disorders. He called attention to the fact that workers throughout the world are now concerning themselves with this point of view. He mentioned particularly the work of George Draper and his constitutional clinic at the Presbyterian Hospital in New York and the work carried out by Raymond Pearl and his co-workers in the division of human genetics in the constitutional clinic in Johns Hopkins Hospital. Individuals have been measured with relation to the

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Where glass is spun into fine "wool"

various diseases from which they have suffered, the records of their ancestors have been investigated, and it is now realized that the heredity and the constitution of the individual are of utmost importance in the diagnosis and treatment of disease. The mouth may contain extra teeth or be deficient, the palate may fail to close and there may be hare-lip. Tongue-tie may be manifested through several generations. Various forms of indigestion have been associated with certain temperaments. Hypertonus of the stomach is associated with hyperacidity and lower tonus of the stomach is associated with lessened acidity.

Individuals of the heavy athletic type with short chests and long abdomens are likely to have stomachs of increased tonus with the digestive organs high in the abdomen. The individual of frail physique with long chest and a short abdomen is likely to have a poor tone to the stomach and the stomach and intestines will be found low in the abdomen.

Draper found that people with narrow facial angles and forward slanting teeth were likely to have the navel in a lower location than normal, and were likely to be sufferers from ulcer of the stomach. People with gall-bladder irritations were of a steady and more continuous form of behavior, whereas those with ulcer of the stomach were unstable and react quickly to their environment.

Cancer of the gastro-intestinal tract has been shown by Professor Maud Slye to be inherited through many generations of mice, and she has shown the possibility of breeding cancer out of the group as well as breeding it in.

The greatest study of mankind is man, and it is important to realize that it is man as a whole that must be studied as well as the individual features.—*M. F.*

UNIQUE PLANT PRODUCES GLASS WOOL FOR STORAGE BATTERY PLATES

PRIOR to the World War, glass wool was imported almost entirely from Germany for the few specialized uses to which it was put in this country. At that time it was known best in the form of ink erasers and was also utilized somewhat in chemical laboratories as a filtering medium. About ten years ago a demand arose for glass wool on the part of storage battery manufacturers. Accordingly, a plant was built in Millville, N. J., in the heart of a glass producing region, for the manufacture of glass wool. This plant, the only one producing this material in the United States, was described in a recent issue of *Chemical and Metallurgical Engineering.*

Fundamentally, the process of manufacturing glass wool is simply that of heating a glass rod to the softening temperature and then drawing it out into a fine thread. While in slow rotation, the glass rod, which is about three-fourths of an inch in diameter, is constantly heated and softened at its extremity by a small, regulated gas flame. When the glass tip has reached the proper initial softness, an operator touches it with a cold rod and, having accumulated a small "gob" of molten glass, carries it about 15 feet to the top of a large rotating wheel and releases it there. The wheel takes charge from then on; the strand that has been pulled over this distance remains unbroken and is wound on the wheel.

In this unique plant of Friedrich and Dimmock, there are 12 batteries of glass rods and wheels installed. Within 3000 square feet of floor space, some 500 pounds of glass wool are produced daily.

The rod holders operating from one main shaft are mounted on a special iron structure. At one end the 12 horizontal rods are inserted in the centers of individual interlocking gears arranged in a vertical zigzag fashion; these gears transmit the desirable slow rotation. At the other end the rods project through and rest on holes in a vertical panel, which gradually retreats to the stationary end as the rods are used up. On the edge of this panel is fastened a narrow gas pipe, having 12 small jets which melt the protruding glass rods and follow them to their disappearance.

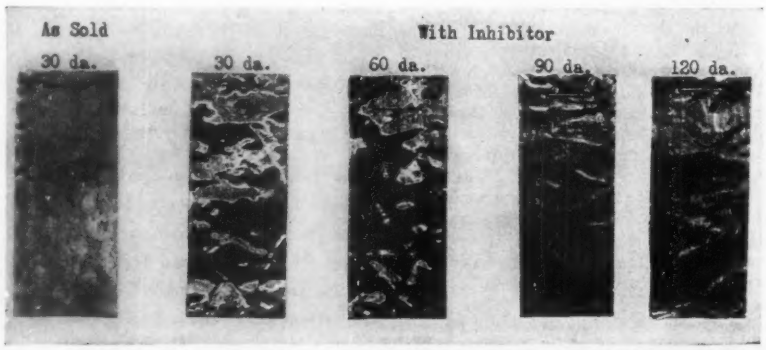
The noteworthy characteristic of this arrangement, shown in the illustration, is its automatic and inevitable synchronism. Once the operator has strung the 12 strands of each battery over their common wheel—a matter of a very few minutes—nothing further need be done until the rods have run out. That is to say, with a given motor speed, the gears will rotate the rods, the gas flame will melt the glass, and the winding wheel will draw the strands, all in a fixed correlation that will give a definite strand size. Thus, if the motor is slowed down, the whole process must adjust itself to produce a heavier strand. What may appear unusual, finally, is that no breakage of the thin glass strands occurs as they traverse the 15 feet of space between units.

The glass wool is finally stripped from the collecting wheels and either shipped in hanks or fabricated into battery insulating plates within the plant. The latter are made from uniform layers of wool that have been dipped in glue and dried in a convection chamber. They are shipped as porous plates with firm smooth sides. Glass wool is also used in filters and light diffusers, and recently as insulation for mechanical refrigerators.—*A. E. B.*

SODIUM SILICATE INHIBITS CORROSION

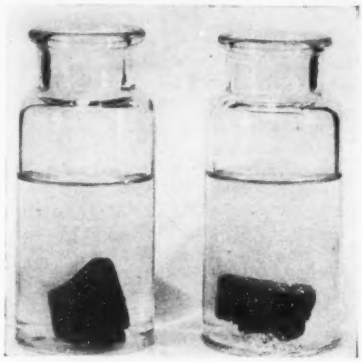
MANUFACTURERS of shaving soap and cosmetics are increasingly favorable to the use of collapsible tubes as containers for their products. However, one great technical difficulty has militated against the use of this convenient package —namely, the inevitable corrosion of the aluminum tube. Ordinary shaving creams with a soap base, and various alkaline cosmetics, will attack an aluminum tube and in many cases cause its failure within a few weeks, at temperatures well within the range of atmospheric exposures.

Mr. James G. Vail, Vice-President of the Philadelphia Quartz Company, writing in



Test sections cut from shaving cream tubes. The sample at the left shows a dull corroded surface after 30 days. The others show the brilliant surface of aluminum after several months when sodium silicate is used in cream as an inhibitor

a recent issue of *Industrial and Engineering Chemistry* announces the discovery that the addition of less than 0.5 percent of sodium silicate to the soap will stop this corrosive action so completely that the metal remains bright after many months. Sodium silicate used for this purpose is known as an inhibitor and its effectiveness as a corrosion resister is clearly demonstrated in an accompanying photograph. The effect of much larger silicate additions than are needed to stop corrosion has been tested by supplying



Effect of silicate treatment on brick exposed to sulfuric acid. The sample at the left was treated before immersion. That at the right was immersed without treatment. Note the deposit of decomposed brick that has settled to the bottom of the solution in the bottle at right

them for regular use to men who did not know their composition. Some noticed more abundant lather but no unfavorable criticism developed.

Another inhibiting effect of sodium silicate which is not yet thoroughly understood, is its power to impart resistance to acid corrosion to such materials as Portland cement or ordinary red brick. The surface of the cement or brick is coated with a dilute solution of sodium silicate which penetrates the pores and results in increased resistance to corrosion, abrasion, and penetration of oil and water.—*A. E. B.*

EAR-PHONE DERMATITIS

As more and more strange chemical substances come into industry, new cases of inflammation of the skin due to special sensitivity are reported. When Mah-Jongg became the popular American craze, innumerable cases of sensitivity to the Japanese lacquer used on the Mah-Jongg boxes or tiles were reported in medical literature. A few years ago specialists in diseases of the skin became aroused over the number of cases of people sensitive to the ink used in rotogravure sections of the newspapers.

Now Dr. J. J. Eller of New York reports the case of a man who had inflammation of the skin over both ears and covering the skin just in front of the ears. The patient had used radio ear-phones for two hours, following which his ears itched and burned and became slightly swollen. After several weeks the swelling gradually increased so that eventually both ears became twice their normal size and then the condition gradually subsided. Similar cases have been reported by other physicians.

(*Please turn to page* 482)

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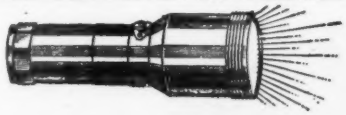

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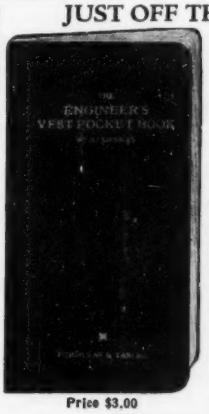

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THE AMATEUR ASTRONOMER

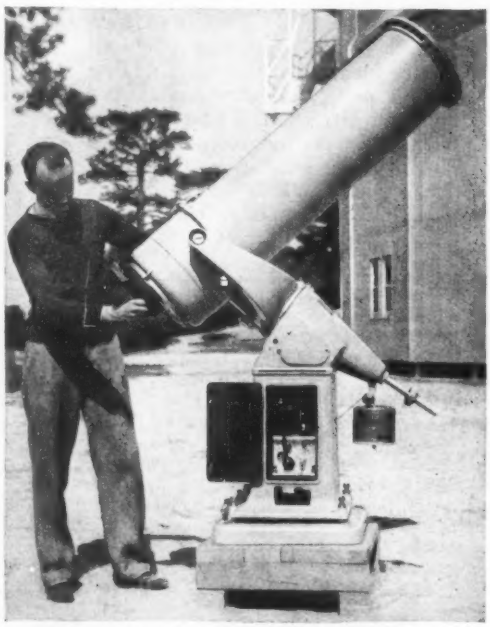
Conducted by ALBERT G. INGALLS

IN the October number, page 320, we reproduced a photograph of one of the four-inch refractors especially designed for the study of various proposed sites for the 200-inch telescope. We now show a photograph of one of two 12-inch Cassegrainian reflectors designed by Russell W. Porter, and approved by Dr. John A. Anderson in charge of the site investigation, for the same purpose. The photograph was sent us by Mr. Joseph O. Hickox of Mount Wilson Observatory. Accompanying it is the following comment:

"Several 12-inch reflecting telescopes have been made for the California Institute of Technology for the purpose of testing seeing conditions at the various sites being investigated for the location of the 200-inch telescope now in course of construction.

"The Pyrex mirrors for the 12-inch reflectors were figured in the optical shop of the Mount Wilson Observatory at Pasadena. The primary focus is five feet, but a Cassegrain focus is available which gives an equivalent focus of 20 feet. Eyepieces of 60, 320, and 480 power are used, the 'seeing' being judged by observing the separate of double stars, the diffraction pattern around stars, and the quality of the detail seen on the moon and planets.

"The mounting is of duralumin, the weight of the complete telescope being 235 pounds. It is provided with reading circles and slow-motion adjustments for right ascension and declination, and is driven by a clock actuated by a weight."



Cassegrainian for 200-inch site investigation

The photograph reproduced was shown to Russell W. Porter, designer of the telescope, who was induced to dictate the following additional comment: "The specifications laid down for this particular mounting were that it should be very rugged and stand rough treatment, as it was intended to be transferred from one site to another on the backs of pack mules or men, and to be easily separated into convenient units for packing. These considerations made it desirable that all delicate parts be enclosed, as far as possible.

"The entire mounting is of duralumin castings; the tube is of sheet aluminum; the worm gear and adjusting screws of bronze. The only steel in the mounting is the lower bearing of the polar axis and the declination studs. These are chromium plated. The clock weights will drive the clock for 40 minutes before rewinding. The yoke, which is hollow, is especially rugged, and the declination arm and tangent screw are inside one of the arms. A slip ring at the upper end of the polar axis is divided into hour angles, allowing quick setting on any star in right ascension. Hand control in right ascension is by a removable key which engages the worm, whose end can be seen in the little hole on the base casting, just below the yoke.

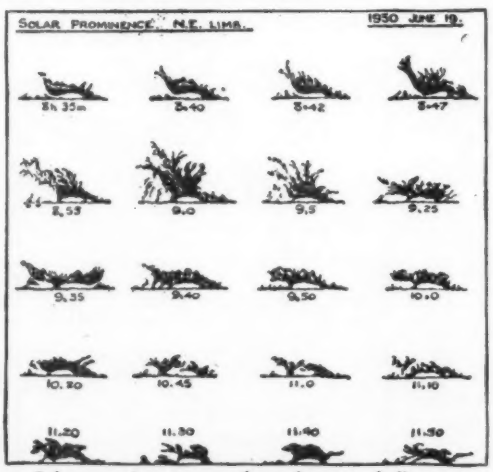
"The cell holding the 12-inch primary mirror is fastened to the casting at the lower end of the tube by a threaded joint making about a half turn. This is not visible on the photograph but lies about halfway between the declination stud and the bottom of the cell. This method of attachment allows the mirror to be removed for safe keeping and to go back again to a positive stop, thus preserving the alignment.

"The whole instrument was painted a light gray with a dull finish and worked down to a beautiful white finish.

"The two telescopes were made by Fred G. Henson of Pasadena. Preliminary tests of the instruments on close doubles showed that the optical surfaces exhausted the resolving power."

THE number of spectrohelioscopes attempted thus far is disappointing. Perhaps the insertion of the series of sketches shown on this page, which gives a concrete idea of what the amateur may expect to see with a spectrohelioscope, may serve to arouse further interest. These sketches were drawn from a solar prominence observed during the morning hours of June 19, 1930 by F. J. Sellers, F. R. A. S., and are reproduced from the *Journal of the British Astronomical Association*. Mr. Sellers points out that this prominence was not a large one, as prominences go, though it was very active. At 9 o'clock A.M. it had reached a height of about 30,000 miles, having risen at the rate of about 12 miles a second.

Seen through the spectrohelioscope these prominences are red and are a moving sight in more senses than one. There are plenty of them; Russell, Dugan and Stewart's "Astronomy" states that it is not at all unusual to find as many as 20 at once on the sun's limb. In 1916 (May 26) one was seen to reach the height of 500,000 miles, ascending at the rate of 20 miles a second. Can you imagine yourself sleeping late on a Sunday morning if you had a spectrohelioscope and could watch such stupendous cosmic events as these? Golf would not pull you away from the eyepiece, nor would motoring. No doubt when the dinner hour came your family would have to feed you forcibly.



Solar prominence seen through spectrohelioscope

FOR some months we have known that Professor George W. Ritchey had secured the necessary financial backing to begin work on a large telescope of the Ritchey-Chrétien type. He now has made this fact public. He proposes to build a reflecting telescope, of aperture not yet announced, and Miami, Florida, has been selected tentatively as the site. Robert Henkel, Gar Wood, the speed boat builder (who long has been an enthusiastic amateur astronomer), and other Detroit people are his backers. G. H. Lutz ("A. T. M.," pages 243-244) will assist him.

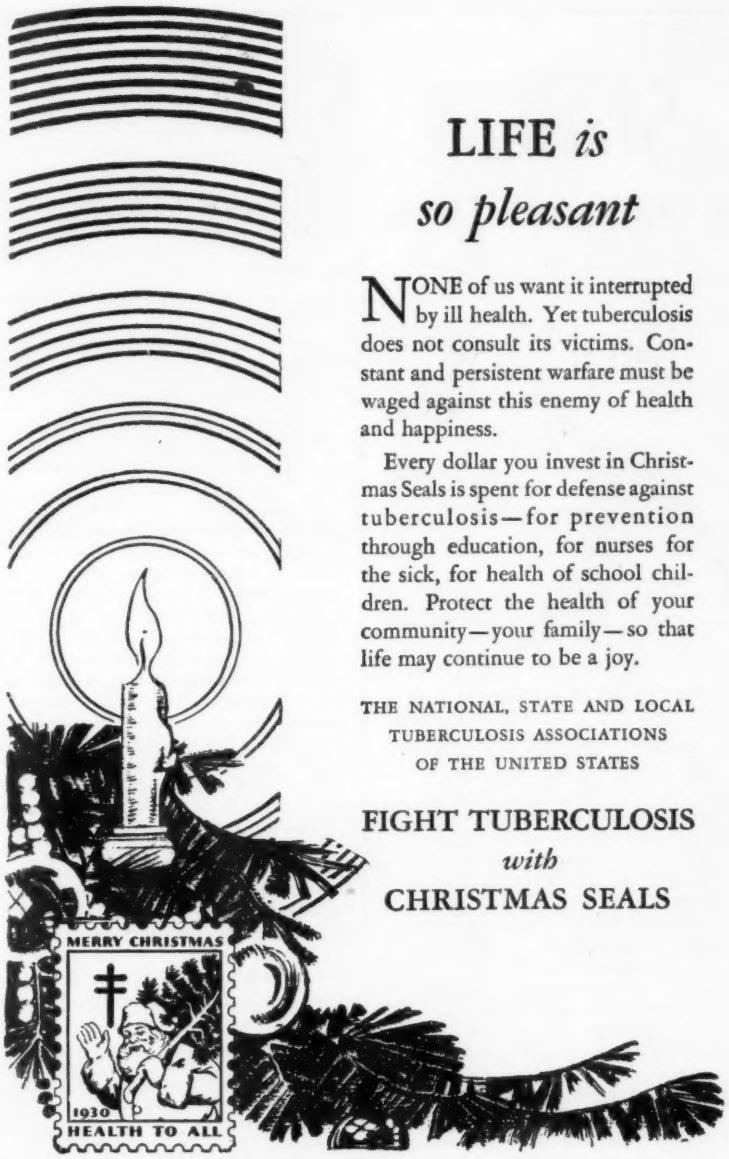
The Ritchey-Chrétien telescope was described by Professor Ritchey in a long series

of articles in the *Journal of the Royal Astronomical Society of Canada*, beginning with the May-June, 1928 number. It has a short focal ratio and resembles a Cassegrainian except that, instead of a parabola and hyperbola, a combination of new curves is used. This does away with the distortion of stars not in the center of the field, from which all existing reflecting telescopes now suffer. He also plans to use curved photographic plates accurately ground and polished to a sphere of long radius, since the image projected by the mirror or mirrors of a reflector is not flat but is curved or "dished." He has developed several other extreme refinements, all of which if successfully compounded in one instrument should bring about a striking advance in the technique of telescope making and use. [These mysterious curves have been described—mathematically—in the *Revue d'Optique* (Jan. and Feb. 1922). How to put them on glass never has been described. Don't ask us; we don't know. We asked Professor Ritchey once and his reply was that it is "simple," but he did not describe the method.]

CHICAGO now has an organized group of amateur astronomers and telescope makers, so W. L. Dennis, secretary of the Pickwick Society, 4653 Addison Street, Chicago, has advised us. The Pickwick Society is an established amateur scientific organization but its telescope making activities are new. Its membership includes the professional telescope maker John F. Mellish and Professor Philip Fox, Director of the Adler Planetarium, who will act as advisors. The Society already has a seven-inch, two eight-inch, and a ten-inch reflector. Its activities will center in the Planetarium where meetings will be held. Mr. Dennis asks us to enlist the support of all amateurs in the Chicago district. We wish more power to the Pickwickian elbows. What city is next?

WE learn that the Corning Glass Works (Corning, New York) now has available some standard Pyrex sight glasses which happen to be quite suitable for telescope mirrors. There are several sizes: 6 by ½ inch; 7¼ by ¾; and 9 by ¾. The prices are low. These disks seem pretty thin but should "get by" in nearly every case, as the 8 to 1 ratio usually specified allows a large factor of safety. They often contain bubbles but that can't be helped and these do little or no real harm.

TO complete this month's batch of odd items, here is one furnished by J. V. McAdam, Hastings-on-Hudson, New York. To avoid bubbles in a pitch lap, pour melted pitch on cold tool to half desired thickness and on face of cold mirror (first wet with rouge or soapy water) to equal thickness, and then lay the mirror disk on the other, pitch to pitch. Try it. Mr. McAdam also has modified the Rogers finder (see SCIENTIFIC AMERICAN instruction book "Amateur Telescope Making," page 232) by inserting a monocular in the side of the tube, pointed at a second prism mounted within the tube and in line with the main prism where it intercepts no extra light. An ingenious wrinkle. Although it requires a larger prism, it reduces the number of outside gadgets on the telescope and renders the instrument less vulnerable.



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THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 479)

Ear-phones are made of two compositions: (1) A compound with phenol, similar to Bakelite; (2) A laconite compound which is a mixture of pure shellac, rosin, gum, mica filler, marble dust, and carbon black. Cases of inflammation of the skin have developed from both types of ear-phones.—*M. F.*

SYNTHETIC PRODUCT FOR FIREPROOFING WOOD

AMONG the many new developments in chemistry disclosed at the recent meeting of the American Chemical Society was the announcement of a new series of compounds known as chlorinated diphenyls. These substances are derivatives of a new synthetic chemical diphenyl, described recently in these columns. Diphenyl is a milk-colored substance made by uniting two molecules of benzene and is used commercially as a substitute for steam for carrying heat in gasoline refining. By adding chlorine in various amounts to diphenyl, a series of derivatives is obtained, ranging in variety from a substance resembling water to light oils, thick syrupy substances, and a light, amber-colored solid.

In a paper describing this substance, C. H. Penning lists various commercial applications for the new compound, such as protective coatings, water-proofing, flame-proofing, molding, electric insulation, adhesives, printing inks, artificial leather, leather finishing, textile finishing, sealing waxes, and chewing gum.

"One of the first uses considered when the non-inflammability of the resinous form of chlorinated diphenyl was discovered was as a fireproofing agent for wood," Mr. Penning states. It was found that a practically fireproof product could be obtained, but at a cost considerably greater than when the common mineral salts such as ammonium phosphate, are used. The treated wood, however, instead of being brittle and lifeless, as is the case with the mineral salt processes, gains in strength, and is indeed a superior product.

The thick, oily varieties of chlorinated diphenyl promise to be valuable for their high dielectric constant and resistivity, and their low power factor. These insulating properties make them of great interest to manufacturers of electrical equipment.—*A. E. B.*

CIGARETTE SMOKERS COMPETE WITH GAS

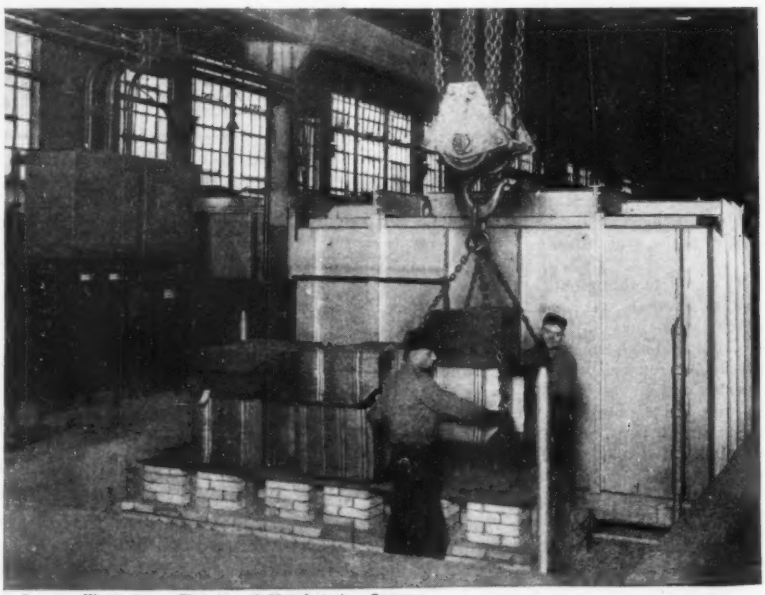
THE people of the United States smoked 127,400,000,000 cigarettes in 1929. If each smoker produced 3½ cubic feet of smoke from each cigarette, the aggregate smoke would just about equal the volume of manufactured gas used in the United States in the year.

BRITISH RIDE ON RUBBER BRICKS

RUBBER bricks have been used in slapstick movie comedies for years, but in some parts of Great Britain the streets are now paved with them. In a report to the Sixth International Road Congress, held in Washington recently, a British delegation told of the success that rubber paving has had in London, Newcastle, Edinburgh, and Glasgow.

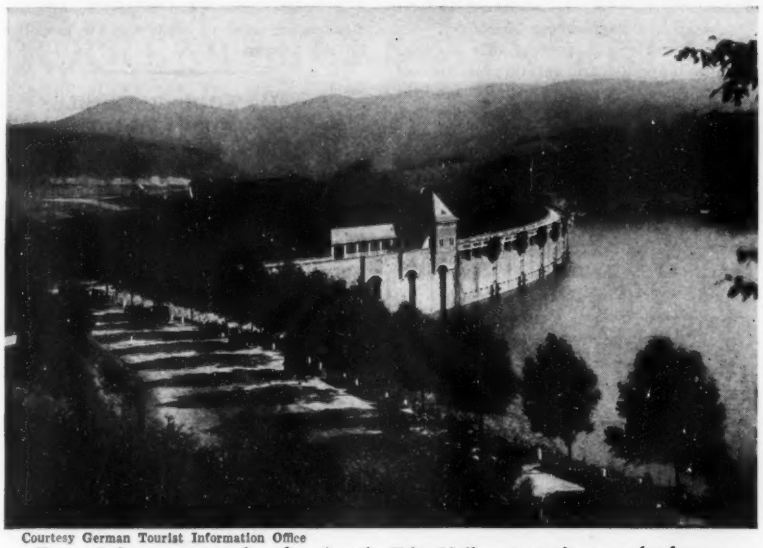
The first experiments to substitute rubber for brick and asphalt were made in 1913, it was stated. A rubber pavement in Glasgow, consisting of blocks of rubber 9 by 4½ by 1½ inches, was laid on a concrete base in 1923.

"Traffic in Glasgow is of the heaviest



Courtesy Westinghouse Electric and Manufacturing Company

Where "the mountain comes to Mahomet." This bell-type furnace is a recently developed time-saver for heat treating metal in great quantities. The metal to be treated is arranged on top of a base, of which a number are supplied, and a crane covers it with the inverted box-like lid which contains the electric furnace. A number of these furnaces may be operated at one time



Courtesy German Tourist Information Office

Europe's largest power dam forming the Eder Valley reservoir, near the famous health resort, Bad Wildungen. The beautiful lake formed by the impounded water is nearly 17 miles long, ⅝ of a mile wide at its widest point, and has an extreme depth of 137 feet. The sites of three villages were covered. The dam is nearly 150 feet high, 900 feet long at the bottom, and 1300 feet at the top. It has the fourfold purpose of maintaining water in the Weser for shipping, feeding the Mitteland Canal, preventing floods, and furnishing water for power

and most trying class," the report stated. "The cap of one block came away from its tread in 1925. This is the only defect reported. The paving is in good condition and shows no apparent wear after six years' use."

An installation in London was in New Bridge Street, which bears some of the city's heaviest traffic, with 17,623 vehicles, or 51,100 tons between 8 A.M. and 8 P.M., in addition to considerable night traffic. This was laid in 1926.

"After two years of wear, 416 blocks, or say 4 percent, were renewed, and now at the end of the third year approximately another 10 percent have to be renewed," the report stated. "The defects are in the nature of blisters and the subsequent peeling off of thin layers of the cap where blisters appeared. The layers stripped off in no case extend the full surface of a block and are about one fifth of an inch thick; the defects cause no inconvenience to traffic, but they collect dirt and are a blemish."

The paving costs about 22 dollars a square yard, laid without foundation, it was stated.—*Science Service.*

FISH-BONE IN THE LIVER

ORDINARILY a fish-bone seldom shows a shadow when the X ray is used to discover its presence in the human body. Occasionally, however, such a bone may be of such size and density as to be easily visible. Such was the case in a woman, 36 years of age, who had all of the symptoms of gall-bladder disease and who went to a hospital for that complaint. When an operation was performed on the gall-bladder, an abscess was found in the side of the liver and a large, thick fish-bone almost an inch long was removed with the matter from the abscess. Apparently when the woman swallowed the fish-bone it stuck in the wall of the small intestine, which then became adherent to the lower surface of the liver. The fish-bone passed through the wall of the intestines and on through the liver because some of the liver became adherent to the wall of the abdomen.

A careful study of the X ray plates made beforehand revealed the presence of the fish-bone as marked on the plate, although it had been overlooked previous to the operation.—*M. F.*

DISCOVER QUEER PROPERTY OF LIVE WIRES

DOES the passage of electricity through a copper wire cause a change in the properties of the metal? G. C. Oland and C. E. White proved to a recent meeting of the American Chemical Society that it does. The discovery was made by submerging a "live" wire and a "dead" one in an acid solution and measuring the amount of metal dissolved from each in a given time. It was found that less copper dissolved from the wire carrying current, either alternating or direct. Strangely enough, however, when lead, nickel, aluminum, or iron wire was used, the metal was attacked more readily while it was carrying a current.

Encouraged by this discovery, the chemists are continuing their experiments to discover the exact physical and chemical changes caused in a metal by the passage of electricity. Perhaps their work may eventually enable chemists to answer the question that has "stumped" physicists and electricians—what is electricity?—*A. E. B.*

BEETLES CHEW HOLES IN LEAD PIPES

THE supposition that metals can be injured by boring and gnawing insects has been confirmed recently by O. Bauer and O. Vollenbruck as a result of systematic experiments in the Kaiser Wilhelm Institut für Metallforschung and in the National

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Bureau for the Testing of Materials, says *Industrial and Engineering Chemistry*.

The animals that possess this peculiar metallic appetite are certain varieties of beetles and they are especially fond, it seems, of lead. Cases are on record where the insects have ruined lead, water, and gas pipes, tanks and cisterns, telephone cables, and lead stereotype plates. No attacks of the beetles on aluminum, zinc, or brass could be verified.—*A. E. B.*

DIAGNOSIS OF TRIPLETS BY THE X RAY

OBVIOUSLY it is of importance to diagnose the presence of twins and triplets before their birth. There are many ways in which the physician may do this.

Triplets revealed by the X ray

He can locate two heart beats, he can feel with his hands the outline of two heads and two spines, and there are various other ways by which he can gain information with his ordinary senses. When, however, there are three children present the situation becomes much more difficult. Hence it is that the X ray was warmly welcomed by the obstetrician as an aid in his work. Dr. Leo A. Rowden in the *British Journal of Radiology* presents the X-ray picture of a case in which, because of the large size of the abdomen, the presence of twins was suspected. Pictures taken from the front and from the side indicated the presence of triplets that lay in the abdomen in various positions. The three children were born on September 19; two of them arrived in the normal order and one reversed.—*M. F.*

SMOKE-POT WIND INDICATORS

UNITED AIRPORTS of California is marketing with some success a smoke-pot wind indicator. The smoke pot uses cheap fuel oil, holds 25 gallons at a filling, and will produce smoke continuously for 12 to 15 hours without refilling. Any shade of smoke from black to white can be readily produced in accordance with local conditions. The smoke column is heavy and tends to roll along the ground for several hundred feet. Its nominal cost is worth considering. But the mere size of the column as compared with a wind cone or vane is more of an advantage. Also the column bends and veers with every gust and so gives the pilot a precise and instantaneous idea of what the air is doing on the ground.—*A. K.*

FOSSIL WOOD RESEMBLES MODERN PINE

A PIECE of petrified wood from Yellowstone National Park, so perfectly preserved that even the finest microscopic details are practically as clear under the high-power lens as those of modern wood, is described and illustrated in the *American Journal of Botany* by Prof. H. S. Conard of Grinnell College.

It was found in a region where the only previously described petrified woods were those of redwood trees, but its structure is more closely akin to that of one of the species of pine found in the park. Before it could be studied and photographed under the microscope, bits of it had to be ground down thinner than tissue paper, so that light would shine through.—*Science Service.*

OUTBOARD MOTOR AERATES FROZEN LAKES

OUTBOARD motors, advertised by manufacturers as a most valuable aid in transporting fishermen to the scene of their nimrod activities, take a new rôle in the winter—this time assisting the fish. This information was recently received by the Johnson Motor Company, Waukegan, Illinois, from a South Dakota dealer.

In one instance the state game warden called on W. T. Williams, Watertown, South Dakota, owner of an outboard motor, to save the fish suffocating under the ice in a small lake near Goodwin.

Mr. Williams built a stone-boat frame to set his motor in, and hung it at a tilt in a hole through the ice about three feet by six feet. In this position the propeller of the motor threw a heavy flow of water out and over the top of the ice. About 300 feet from the motor, he cut five holes about three feet in diameter, as shown in the accompanying sketch.

The motor was started and ran six days and nights constantly. About every six or

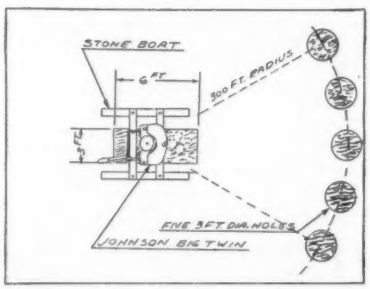

Diagram of how an outboard motor was used to aerate a frozen lake

eight hours the motor had to be moved back several feet because of the washing away of the ice.

During the six days a crew of fishermen seined 760 dollars' worth of scavenger fish from the lake, leaving an aerated lake with enough fresh water to save the game fish.

Several times after long continued cold spells, the state game and fish commission have aerated various lakes in this manner.

CURRENT BULLETIN BRIEFS

SHORT REVIEWS OF BULLETINS AND PAPERS ON SCIENTIFIC AND ALLIED SUBJECTS, AND WHERE TO GET THEM

STAPLE VITREOUS CHINA PLUMBING FIXTURES (Commercial Standards CS 20-30, Bureau of Standards) gives valuable diagrams (with sizes) of various plumbing fixtures. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

COPPER ELECTROTYPING (Circular of the Bureau of Standards, No. 387) gives an exceedingly valuable resumé of the process and will prove valuable to all who are in any way interested in plating. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

ANNUAL STATISTICAL REPORT OF THE AMERICAN IRON AND STEEL INSTITUTE FOR 1929 gives 129 pages of carefully prepared statistics, the tables being very authoritative. *American Iron and Steel Institute, 75 West Street, New York City.—$5.00.*

THE DIFFERENTIAL ANALYSIS OF STARCHES (Publication 275—Field Museum of Natural History, Botanical Series Vol. IX, No. 1) by James B. McNair. *Field Museum of Natural History, Chicago, Ill.—50 cents, plus postage.*

GROWING BLACK LOCUST TREES (Farmer's Bulletin, No. 1628, U. S. Department of Agriculture) by Wilbur R. Mattoon, tells how to grow trees for which there is a demand, particularly for fence posts, stakes, insulator pins, and tree nails. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

ENGLISH SPARROW CONTROL (Leaflet No. 61, U. S. Department of Agriculture) by E. R. Kalmbach gives economical and effective methods for local control of this pest. While the nestlings eat insects, this is only for ten or twelve days, whereupon they become confirmed vegetarians. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

DE FLOREZ MANUAL CONTROL SYSTEM (Bulletin No. 7520). With this system the operator can almost "feel" the movement of the distant control. The pamphlet tells how. *The Brown Instrument Co., Philadelphia, Pa.—Gratis.*

FIFTY COMMON PLANT GALLS OF THE CHICAGO AREA (Botany Leaflet 16, Field Museum of Natural History) by Carl F. Gronemann, while perhaps of local interest, gives excellent illustrations which are botanically correct. *Field Museum of Natural History, Chicago, Ill.—25 cents.*

PASSING THROUGH GERMANY is the title of a delightful little travel book of 225 pages, beautifully illustrated. It is not a guide book in the ordinary sense, but takes care of such subjects as the fine arts, vacation study, German politics, et cetera. This beautiful little book is sent for the cost of the postage which can be remitted by two international reply coupons which will cost ten cents.—*Terramare Office, Wilhelm Strasse 23, Berlin, S. W. 48, Germany.*

FUNDAMENTALS OF PATTERN DRAFTING FOR SHEET METAL SHOPS is an excellent little treatise on the subject and is well illustrated. *Publicity Department, The American Rolling Mill Co., Middletown, Ohio.—Gratis.*

HOW WE MAY GET VITAMIN A; B AND G; C; D (Extension Circulars, Extension Service of College of Agriculture, University of Wisconsin) are four little pamphlets giving radio talks by Mrs. May Raynolds of the Home Economics Department, University of Wisconsin. *College of Agriculture, University of Wisconsin, Madison, Wis.—5 cents each.*

WAYS AND MEANS TO TRAFFIC SAFETY gives the recommendations of National Conference on street and highway safety as summarized and approved by the Third National Conference, May 27-29, 1930. *National Conference on Street and Highway Safety, 1615 H. St., N. W. Washington, D. C.—Gratis.*

AERONAUTIC PUBLICATIONS (Aeronautics Bulletin No. 6, Aeronautics Branch, U. S. Department of Commerce) is a valuable pamphlet citing books and periodicals pertaining to aeronautics. It also gives a complete list of the Aeronautics Bulletins, 25 in number, which are sent free (with one exception) to interested parties. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

THE AERONAUTICS BRANCH, DEPARTMENT OF COMMERCE (Institute for Government Research, Service Monographs of the United States Government No. 61) by Laurence F. Schmeckebier, deals with the history, activities, and organization of this important branch of the government service. It contains much information unobtainable elsewhere. *The Brookings Institution, Washington, D. C.—$1.50.*

OBSERVATIONS ON THE POSSIBILITY OF METHYL CHLORIDE POISONING BY INGESTION WITH FOOD AND WATER, by W. P. Yant, H. W. Shoaf, and J. Chornyak. While there is no definite evidence that food poisoning has occurred or that this type of hazard exists with the refrigerants in current use, nevertheless, the possibility is a matter of concern to manufacturers of refrigerating devices and products, to health officials, and to the public. This detailed study will prove of service to all such persons. *The Roessler & Hasslacher Chemical Co., Niagara Falls, N. Y.—Gratis.*

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OUR POINT OF VIEW

(*Continued from page* 429)

from laying off men or reducing wages. Nor is there much substance in the statement that this reduction does not add to the unemployed because men are not discharged until the end of their enlistment. There is a continuous outflow of men from the Navy and unless there is a corresponding intake, the average in the Navy quickly drops. Briefly stated, the Navy Department will draw upon the labor market for just 4800 less men after this reduction, and the ranks of the unemployed are swelled by exactly the same number.

We sympathize with the President's effort to reduce government expenditures in order to avoid raising the income tax; we are aware of the enormous strains put on the Treasury by the operations of the Farm Board, the building of Hoover Dam, the accelerated public-building and road program, and last, *but not least*, the increased cost of prohibition enforcement; we know that powerful interests would oppose any cuts in these expenditures, while there will be few in public place to protest a naval slash. Some of the President's advisers may think it is good politics to save at the expense of the Navy, but we know they are wrong and are confident that the great inert mass of unorganized Americans, patient though they be, will find a way to show their resentment of a continuous surrender of national interest to placate organized groups held together by fanatical, short-sighted, or selfish motives.

Continued Unrest In South America

BRAZIL, the largest and most important of the South American states, is in the throes of a revolution that appears at this writing to be succeeding. Already more blood has been spilled in Brazil than in the "palace revolutions" of Argentina and Peru. Probably the fundamental cause of this revolt is the economic depression occasioned primarily by the low price of coffee, Brazil's great export commodity; the alleged cause is that President Luis was elected by gross frauds perpetrated under the protection of the army; unquestionably, the rather easy successes of the revolutionists in Peru and Argentina, followed by their rapid recognition as *de facto* governments by this country, encouraged the present outbreak in Brazil.

This present unstable condition throughout Central and South America, we feel sure, is being carefully considered by the State Department. In general the European powers follow our action in extending recognition to the revolutionary governments, so that our responsibility, though undefined, is immense. Usually our government views with disfavor any violent usurpation of authority, and in a treaty with the states of Central America agreed to withhold recognition from a government based on force. This agreement does not extend to states of South America, and obviously different conditions will require different methods of treatment.

Our investments in Central and South America are colossal. One expert estimates that we have a total investment of 6,000,000,000 dollars in these countries and an annual export trade to them of 1,000,000,000 dollars. Brazil alone takes 100,000,000 dollars of our exports annually; Argentina, 180,000,000 dollars; Cuba, 125,000,000 dollars; and Mexico, 115,000,000 dollars. Thus we have a large economic interest in our southern neighbors.

In addition to the revolution in Brazil, President Machado of Cuba has been authorized by the Cuban congress to suspend the constitutional guarantees in that country on account of threatened outbreaks in Havana. There are also fresh indications of unrest in Mexico. Former President Portes Gil, resigned as head of the National Revolutionary Party, and General Plutarco Calles, reputed strong man of Mexico, issued a warning that the Government must purge itself of disloyal factions. Presumably in response to this threat, Louis Leon, Secretary of Labor and Commerce, resigned and other cabinet retirements are rumored.

The Monroe Doctrine effectively prevents European intervention in South American affairs. It therefore carries a moral obligation on our part to exercise the stabilizing influence which would otherwise be exerted by the Great Powers of Europe. The extent and nature of our intervention in the affairs of our proud Spanish-American cousins can only be determined after careful consideration of the many factors involved; each situation that arises has to be considered on its own merits since no precise rules can be formulated that will cover the various crises that continually arise.

Americans will understand the delicate dilemmas that almost continually confront the Department of State if they will visualize the Latin-American situation as it actually exists and realize that republican institutions and representative governments are ill-adapted to the genius, habits, and mental outlook of the Central and South Americans of Spanish descent, who constitute the real ruling class in these countries and who are entirely unconvinced that the ballots of ignorant *mestizos* should decide the destinies of their countries. The great bulk of the peon population is content to leave the government in the hands of the small ruling class, and the so-called revolutions, for the most part, are merely struggles between certain cliques or oligarchies for power. The prevailing economic depression causes unrest, and the oligarchies out of power have simply taken advantage of it to seize the government.

Our interest lies in the orderly self-development of these countries. We can not force this development which must be a slow evolution; we can carefully avoid hindering this development by officious meddling with their domestic concerns, and we can by friendly counsel decrease the number of, and lessen the savage severity that sometimes marks, these revolutionary shifts of authority. And at all times we can protect these states from foreign intervention which would further complicate their already difficult problem.

It is a singularly fortunate fact that Mr. Hoover toured Latin-America prior to his inauguration. This visit, intended mainly as a gesture of our friendship for its people, has furnished him valuable first-hand information of conditions in this important and temporarily disturbed region. The President's personal knowledge of the situation will assist him to determine practical

measures to be undertaken by the United States. And our President should not be hampered in his efforts by uninformed critics or partisan politicians.

The British Imperial Conference THE Imperial Conference composed of delegations from the self-governing dominions and India, opened in London with Premier MacDonald presiding. Many important questions will be considered by the Conference but the most interesting one was disposed of before the Conference met when a member of the British Government formally conceded the right of any British Dominion to secede from the Empire. It had been expected that Premier Hertzog of the Union of South Africa would assert the claim of his dominion to withdraw from the Empire voluntarily, and there were some that professed to believe the British government would contest the claim.

The attitude of the British Government in this matter is just one more instance that the British Empire differs fundamentally from all previous empires, for it is impossible to imagine any other ancient or modern empire permitting a province to pass from its control without a struggle.

The decision of the British Government is probably based on two primary considerations: (1) The inability of the loose-jointed Empire to coerce an unwilling dominion; (2) The unprofitableness of retaining a reluctant member in the Empire. Our successful revolution in 1776 changed the whole attitude of the British people towards their colonies, and the enormous military effort necessary to subdue the Boers in 1899 convinced the British people that it would be poor policy indeed to attempt to keep a dominion in the Empire against its will. The announcement of the government is but an official acknowledgement of an already tacitly accepted principle; none-the-less its formal admission marks an epoch in imperial politics.

In addition to the sentimental ties that bind the dominions to the United Kingdom, there is the very practical consideration that the British Navy and Army are always ready to defend the dominions from external aggression. An Australian or Canadian pays a small tax for the defense of the Empire compared to the tax paid by a resident of the United Kingdom. And we imagine the right to secede will remain in academic abeyance for a long time to come.

The Conference is seriously studying the possibilities of intra-Empire trade, and while the difficulties confronting the Conference are apparently insuperable, it is altogether probable that some measure of trade preference within the Empire will be evolved. It will have to take some shadowy form that will not frighten the Free-traders in the United Kingdom who violently oppose taxes on food, or the Protectionists in the Colonies, who are seeking to build up their factories. Whatever form it takes, any success obtained is almost bound to be at the expense of some of our trade with the United Kingdom and with the dominions. One reason for the British dislike of Briand's proposed United States of Europe was the economic union of continental Europe that would accompany such a development, and the adverse effect it would have on British trade. The struggle for world trade is increasing and is the secret source of many of the so-called policies of the great powers.

A Ray of Hope in China YOUNG Changsu Lin, ruler of Manchuria, took advantage of the exhaustion of the warring factions in Central China, and marched without opposition into Peking. Ostensibly he came to the support of the Nationalist government, the new capital of which is Nanking, which had entirely absorbed its energy in resisting rebellious war lords.

While outwardly the power still is in the hands of the Nationalists, actually it lies with Chang and his army. Manchuria has been enjoying law and order while the rest of China has been devastated by civil war; so far as Chang is able to extend his dominion, he will restore peace to the distracted Chinese. If the Nationalists can accommodate their somewhat visionary plans for a Chinese republic with Chang's personal ambitions, they may obtain the use of his army. This combination would enable them gradually to extend their authority throughout central China. But until there is a much stronger feeling of nationalism and patriotism in China than there is today, all ideas of establishing a unified Chinese republic are chimerical.

Chang's father was too ambitious personally to unite with other Chinese leaders, and it is more than probable that the son will prefer to play a lone hand. If so, his support of the Nationalist government will be of short duration. If, on the contrary, a basis of agreement can be found, a fairly stable government extending from Mukden to Shanghai, including Peking and Tientsin, could be set up. If autonomous governments are achieved by local chiefs in south and west China there would be a lull in the civil wars. In time, if unvexed by foreign interventions, these various Chinese provinces would be drawn into some loose form of confederation; and when roads and railways permit fairly rapid communication between its widely separated provinces, a real unification of China may be expected to begin.

MORE ABOUT PLUTO

(*Continued from page* 447)

keep near one another for almost half a revolution.

At such a time the mutual perturbations must be large, but it will be long enough in all conscience before they can be used to find the masses. Uranus and Pluto also come close to commensurability of periods. for the former completes its revolutions in 84.02 years and three times this is only 2.9 years greater than one revolution of Pluto. The planets therefore return to almost the same relative position after 250 years—during which interval Uranus catches up with Pluto twice.

Figure 3, which is very much like the last one, shows the positions of the planets. At the last conjunction in 1853 the distance of the planets was 30 astronomical units —about the greatest possible. At the next, in 1965, the distance will be only half as great. The perturbations then will be much larger than in the past century and should lead to a fairly good determination of Pluto's mass—*Paris, September 17th.*

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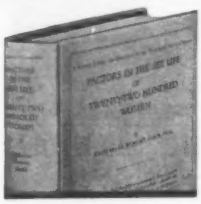
FACTORS IN THE

SEX LIFE

OF 2200

WOMEN

By Katharine Bement Davis, Ph. D.



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AVIATION IN 1930

(*Continued from page 465*)

casualties took place in wrecks, but considering all of them the rate is approximately one death per 300,000,000 passenger miles. For the year 1929 there was a death rate among airway passengers of one death in 9000 flights. If an average trip of 300 miles is assumed, this develops into a rate of one death for each 2,700,000 passenger miles. The discrepancy in favor of the railroad is formidable, still not necessarily too formidable.

What is encouraging is that aviation, whether governmental, engineering, scientific, or operational, is fully aware of the importance of increasing safety. The methods of increasing safety are so numerous that they can only be presented in the briefest fashion. But perhaps the following will give a picture of the energy and comprehensiveness of to-day's effort towards safety improvement.

The Guggenheim Safe Aircraft Competition produced a plane, the *Tanager*, equipped with the famous Handley Page slot, which was able to come to rest in 100 feet after touching the ground.

The National Advisory Committee for Aeronautics has undertaken the systematic study of "spinning," that much dreaded cause of accidents, and is evolving valuable data which should enable designers to build planes immune from such troubles.

The Aeronautics Branch of the Department of Commerce has inaugurated a system of licensing airlines, and of licensing only those airlines which are satisfactory in personnel, equipment, and ground organization.

The perfection of radio communication between plane and airport, and the use of such communication by important airlines has arrived simultaneously with the provision of a nation-wide weather service.

Instrument manufacturers are bestirring themselves to produce instruments which will give reliable indication to the pilot in fog flying. At the same time the technique of fog flying is better understood, and systematically imparted in the training of reserve pilots. (See page 430, of this issue.)

The Bureau of Standards has perfected its system of radio beacons, and is now experimenting with a system which will enable the pilot to land safely in fog.

The insurance companies are inspecting planes and airlines and granting better rates to companies of more than usual status from the point of view of safety.

The Packard Diesel engine for aircraft, allowing the use of heavy fuel-oil, removes or diminishes the fire hazard.

The licensing of schools, and the licensing of transport pilots and ground mechanics is improving the status of the operating personnel.

Safety will come as a result of all such efforts, and their value is cumulative.

The aviation industry is at present undergoing a period of severe depression. Many of the smaller airplane manufacturers are closing down, others are retrenching severely on personnel and cutting down on production; two of the biggest holding companies have issued reports showing enormous losses both absolutely and in percentage of invested capital.

Using a hackneyed phrase, the industry is nevertheless sound. The present difficulties are partially due to the general depression now ruling in the United States, partially to the wave of optimistic enthusiasm which swept over the aviation industry soon after Lindbergh's flight. The manufacturers over-estimated the number of planes the public would buy. The schools over-estimated the number of students likely to enroll. The companies erecting airports over-estimated the growth of student instruction and of private flying, and underestimated the effects of competition in the form of municipal airports. With this enthusiasm there followed a period of overcapitalization, with the public putting up far more money than the industry could profitably employ, so that at the present time the average return on aviation investments is negligibly small.

Yet the industry is growing rapidly all the time. It is only the rate of growth which has been misjudged.

Several favorable factors are already at hand. The Aeronautical Chamber of Commerce reports that the production of new planes is falling slightly behind sales, which indicates that inventories are being slowly liquidated. Severe price reductions which have recently come into effect will hasten this process of liquidation.

Another favorable feature lies in the export of American aircraft. The American industry is exporting an increasing portion of its production. In 1929 nearly 14 percent of its total production value was exported, mainly to Central and South America. At the same time there was a change in the character of the exports. War material and small training planes have been replaced, as far as exports go, by large transport planes of far greater value. As a result of this change, the value of American aircraft exports has more than doubled in the last three years. Nor have exports fallen off substantially during 1930, the worst of all years. For the first six months of 1930 they have totalled 3,256,584 dollars against 3,589,196 dollars in the first six months of 1929.

Again, American air transport is growing rapidly and steadily. The merger of New York, Rio, Buenos Ayres Airlines with Pan-American has resulted in the formation of the largest and most powerful air transport system in the world. In a very few years it will connect every important port in Central and South America with the United States. Pan-American is not only carrying vast quantities of mail, but with the use of large and reliable flying boats or amphibions it is also transporting a larger and larger number of passengers. In the United States progress in air transport is equally rapid. The Aeronautical Chamber of Commerce reports that 133,000 passengers were carried by 29 major transport lines in the first six months of 1929. The poundage of freight and mail was equally impressive, showing 137,398 pounds, with 82,165 pounds carried in the second quarter. The Watres bill which will allow the Postmaster General to place contracts for mail on a space basis and will permit the carrying of mail on passenger airplanes will serve to stimulate the growth of air transport still further.

There is not the slightest doubt that aviation will rapidly work out of the slump and in a few years assume gigantic proportions.

BOOKS SELECTED BY THE EDITORS

ARTIFICIAL SUNLIGHT—*By M. Luckiesh, D.Sc., Dir. Lighting Research Lab., G. E. Co.*

IF Dr. Luckiesh, out of his extensive practical experience with illumination and laboratory testing, set out to write a book suitable for the professional man and intelligent layman alike, he has succeeded in his purpose. Not only the specialist and the general practitioner in medicine, but the average reader would equally well be able to suck the juice from this scientific, technical but not abstruse, though not light-weight, work. Thereafter he would have an advantage over the rest of us who read or hear various claims about the ultra-violet and the infra-red for health benefit but cannot judge of their accuracy because we do not know the "whys" of the subject. But this book is a veritable "why" mine. It covers both solar and artificial radiation and their physiological effects, their measurement, measurement of the ultra-violet, glasses for transmitting it, various artificial sources, and the infra-red.—$3.90 postpaid—*A. G. I.*

STUDIES IN THE LITERATURE OF NATURAL SCIENCE—
By Julian M. Drachman

THE author traces the effect of scientific writing—largely popular and semi-popular, such as that of Darwin, Tyndall, Proctor, Spencer, Eddington—on public opinion and changed public outlook, and therefore on our present age, the Age of Science. Readers who have made an intelligent effort to grasp the real significance of our age in world history will find this book a valuable addition to their library.—$4.20 postpaid—*A. G. I.*

KNOWING that often there is a name or names on the Christmas shopping list for which it is difficult to find something appropriate, we have this month in these pages given you a number of books suitable for Christmas gifts, both for the young and for the adult. We suggest that a well chosen book makes as gratifying a present as can be made.

In the past we have found that many of our readers like to have a cheery Christmas card slipped into the book they give, the donor's name being neatly typed thereon. Our Book Department will be glad to do this for you if you so desire. The whole makes a most acceptable and appropriate remembrance and if you act at once there is ample time to post even to a distance.—*Book Editor*

COMETS—*By C. P. Olivier, Dir. Astronomy, Univ. of Pa.*

THE well-known author of the standard work, "Meteors," foremost American authority on this branch of astronomy, now has written one on the very closely allied subject of comets. It is a popular book of 239 pages and discusses comets from every angle likely to interest all except the incurable mathematician; it is non-mathematical. There has been no such book and this one was needed.—$3.65 postpaid—*A. G. I.*

CLIMATE—*By C. E. P. Brooks, F. R. A. I.*

THIS small work contains descriptions of climates in different parts of the earth. Students of climatology might not find it dull, most others would because of its formal language and the fact that it is for the most part a compilation of statistical data.—$3.20 postpaid—*A. G. I.*

SOIL—*By Archer Butler Hulbert*

"WHAT of the soils?" "What do they produce?" "Could we master the land by the tricks of the trade that we learned at home?"—such questions as these, put to such exploring pioneers as Daniel Boone on his return from the Western Reserve and to Lewis and Clarke on their return from the Pacific, constitute the keynote of this interesting study. It is the story of the influence of the soil on pioneer settlement of this country, with particular reference to migration and the scientific study of local history as it was made by various national groups. "Soil" should be read for its interest and then placed upon one's bookshelf as a valuable reference book.—$2.65 postpaid—*F. D. McH.*

SCIENCE AND THE SCIENTIFIC MIND—*By L. E. Saidla and W. E. Gibbs*

TWENTY-FOUR essays by some of the most noted figures in the world of science, such as Millikan, Soddy, Pupin, Haldane, Slosson, et cetera. An interpretation of those methods of thought which have determined the character of the present age. Five hundred and two pages include valuable appendices of suggested reading and a quite complete list of biographical notes, the whole forming a scholarly and well outlined exposition for mature cultural consideration.—$3.20 postpaid.

THE BOOK OF GLIDERS—
By E. W. Teale

A COMPLETE manual telling all about their construction and operation as well as the history of gliding, with illustrations of famous gliders. The preface is by W. H. Bowlus, American Glider Champion. Clear diagrams elucidate the text and complete plans down to the smallest part are given to build a glider which was especially designed for the book, to take in all the best features of those that had previously been built. Records, licenses, organization of clubs, et cetera, naturally are also included in the volume.—$2.65 postpaid.

THE WONDERFUL STORY OF INDUSTRY—
By E. F. Baker

WELL told stories of how many of the common commodities of our daily life are made; newspapers, matches, bread, ice, glass, hats, shoes, coffee, tea, and so forth. Just such details as will satisfy the inquiring youthful mind. Twenty-five subjects in all and all explained to bring out the romance of manufacture and the dignity of labor. A fine book for the young acquisitive mind.—$2.65 postpaid.

EARLY AMERICAN FURNITURE MAKERS—
By T. H. Ormsbee

QUITE an unusual viewpoint is taken in this survey of the great manufacturers, by stressing the economic, social, and political conditions under which the personality and art of the individual were developed. One hundred and twenty-two illustrations ably depict the craftsmanship of the producer and many chatty narratives give glimpses of the times and customs. A handsome format with end leaves giving an interesting chart of the periods in which the furniture was produced. A fine library volume, with good human interest values.—$3.65 postpaid.

FROM RECENT PUBLICATIONS

FAMOUS EVENTS IN AMERICAN HISTORY—
By Inez N. McFee

JUST as its title proclaims, 20 major events in our history have been selected by this very successful writer, to represent various phases in our national life. With the art of the natural narrator are spread before us the importance and the picturesqueness of heroic accomplishments which were vital steps in our progress, from Columbus to Byrd. The sort of reading grownups as well as youngsters can enjoy. A suitable gift book.—$2.20 postpaid.

HEAR WITH YOUR EYES—*By M. E. Good*

RECENTLY a caller confessed to this reviewer that she had made quite a study of lip reading because she was somewhat deaf and was sensitive about people knowing it. This unique little book outlines by photographs and description a natural method of reading word-forms on the face. The system is simplicity itself and the entire scheme is condensed into 40 pages of text. Sir Richard Paget states that primitive man originated a system of this kind and our modern alphabet developed therefrom. We commend it highly. —$1.15 postpaid.

FOUNDATIONS OF BUDDHISM—*By Natalie Rokotoff*

BECAUSE of the serious unrest in India today this little volume of 137 pages with its crisp, delineating style, will be found to outline clearly the foundations of the forces which keen observers say will eventually make for revolution. One can scarce read with intelligence the news of the day without some background such as is here given.—$1.65 postpaid.

STRATEGY IN HANDLING PEOPLE—*By E. T. Webb and J. J. B. Morgan*

A BUSINESS man and a psychologist have culled much biographical material to illustrate psychological principles with incidents from the careers of famous men and to show how they have handled our own familiar problems in dealing with people. So successfully has this been done that one seems to be reading intensely personal biography rather than an application of psychology. A most unusual presentation approved by a long list of notable scholars.—$3.20 postpaid.

TRAITOR! TRAITOR!—*By J. D. Kerkhoff*

FOR the first time in the English language is told the complex story of the tragedy of Alfred Dreyfus' persecution by the French Army, which stirred the world. His life on Devil's Island beggars imagination for its fiendish cruelty. The acknowledgement of his innocence and the restoration to honor and higher rank with the bestowal of the Légion d'Honneur make some of the most dramatic accounts on record and certainly fail in no point as told by the author. This is an authentic, stirringly dramatic chapter of history that will hold you to every line of the text.—$3.65 postpaid.

THE ATLANTIC—*By Stanley Rogers*

HISTORIES have been written about everything else, why not the history of the Atlantic Ocean—to paraphrase the author. So in most engaging style he sets forth the main events which have taken place thereon; a life story of the old Atlantic herself. The text is charmingly embellished with pen and ink sketches by the author and the whole rivals in interest and instructiveness his previous success "Sea Lore."—$2.90 postpaid.

STORIES OF THE YOUTH OF ARTISTS—
By Mary Newlin Roberts

ANY boy or girl not necessarily artistically inclined, should like these stories of youthful aspirations and dreams of other young people who made their dreams come true. Exceedingly well told in a dignified yet simple manner, the format is most attractive and well executed, the whole forming a book that would be a most acceptable Christmas gift.—$2.65 postpaid.

STORIES OF LOVE, COURAGE AND COMPASSION—
By Warwick Deeping

HERE in 821 pages the author has gathered the best of his shorter fiction: three short novels and 48 short stories covering a tremendous variety of subjects. Appreciators of Deeping will find herein probably a more satisfactory insight into the warmth and breadth of his style and his overspreading humanity than it has been possible to obtain in any one of his previous popular stories. A veritable omnibus of enjoyment.—$3.25 postpaid.

CAMPING AND SCOUTING LORE—
By Atwood H. Townsend

PRACTICALLY every phase of the subject has been fully covered in this very complete book of 366 pages for boys and girls of ages 12 to 16. The author, himself the fifth Eagle scout in Brooklyn, presents the subject in a most admirable and interesting manner. Numerous illustrations amplify the text and can be worked from directly. A fine book for home study.—$3.25 postpaid.

TUNDRA—*By The Eddingtons*

A TALE of romance and adventure on Alaskan trails as told by former Deputy Marshal Bert Hansen to the authors. No more entrancing story of the fortitude, indomitable perseverance, and fearlessness of the real Alaskan has been told. Replete with color of character and colorlessness and bleakness of landscape, one's attention is riveted by the word pictures because of their vividness, so the temptation is strong to finish the book at a sitting. Especially strong in its details of dogs and methods of living.—$2.65 postpaid.

HUNTING THE ALASKA BROWN BEAR—
By John W. Eddy

THIRTY brown bears were met and studied in this particular trip although the author had been observing these animals for years. This type of grizzly is the survivor, practically as it existed in the age of mammals, of the contemporary of the mastodon. A fine story of adventure with 44 illustrations.—$3.65 postpaid.

SEPPALA, ALASKAN DOG DRIVER—
By Elizabeth M. Ricker

THE author, herself the holder of records in "mushing" races, has told the mighty interesting story of this colorful

FOR YOUR CONSIDERATION

character who was born in Norway, emigrated to Alaska during the Nome gold rush, and incidentally became a dog driver. The true story of the rushing of serum to Nome is here told for the first time. Incidentally the real dog hero was *not* Balto, as the world was given to suppose, but Togo the lead dog who carried his team 340 miles to Balto's 53. Both dogs were owned by Seppala. A gripping, fascinating story of hardship and adventure.—$3.20 postpaid.

THE REMINISCENCES OF A MARINE—*By Maj. Gen. John A. Lejeune, U. S. M. C.*

NO more picturesque character has appeared in the annals of this service than the author, who commanded the famous Second Division which took such a prominent part in the late war. Of Arcadian, French, and British ancestry, with firm religious convictions, he was exceedingly popular and ranked among the ablest in the A. E. F. One will find many surprising facets of character hitherto unknown, as well as much important unwritten history in this tremendously interesting and instructive work of 488 pages. Much of the data of events was checked up from the daily letters to his wife which he wrote even in the midst of battle and during his entire career. Practically the last of the principal American commanders to write his memoirs. Don't fail to read it.—$4.20 postpaid.

HERE COMES PANCHO VILLA—*By Louis Stevens*

SO much of romance has been wound about this "genial killer" that it is most interesting and instructive of Mexican life and law to have the story of the real facts concerning this amazing character. Only now since some years have gone by, has the terror of his vengeance passed to the extent that those who know the facts have been willing to tell them. This man for years defied Mexican and United States authority—the best troops of each nation could not capture him. Indeed some believe he is still alive. We who have wondered how he committed his atrocities and got away, will find mighty interesting reading in these pages.—$2.65 postpaid.

ALARIC THE GOTH—*By Marcel Brion*

FROM innumerable ancient sources the story of the man who sacked Rome has at last been fabricated and we find a character quite different from that presented in most of our histories. Fierce and dominant he was but he sturdily defended the crumbling Roman Empire until his disgust at the feeble, vascillating Caesar and the refusal of military rank commensurate with what he considered his services, roused again the barbarian in him. The sack of Rome followed. Informative, historical and entertaining.—$3.65 postpaid.

BABER: FIRST OF THE MOGULS—*By Fernand Grenard*

BORN of the direct line of Tamerlane, raised in a microscopic frontier province whose passes lead to China, by a most astounding sequence of events Baber became the first of the Moguls—creator of an immense empire in India. Infinitely less known than his ancestor, he has taken the prize away in point of grandeur and permanence of accomplishment. His generalship, his political genius, his genius for organization, the worth of the man himself makes one of the most interesting biographies one could conceive—in fact it is practically an autobiography, for Baber himself set down the circumstantial history.—$3.65 postpaid.

REACTIONS AND SYMBOLS OF THE CARBON COMPOUNDS—*By T. Clinton Taylor, Asso. Prof. Chem., Columbia*

A TEXT which develops the study of organic chemistry on the basis of experimental experience by emphasizing the reaction and explaining fully the steps taken to formulate the symbol. Throughout frequent references are made to the literature and the sources of information. 39 chapters, 704 pages, including a very complete index. A thorough and conclusive work.—$4.25 postpaid.

RANDOM GLEANINGS FROM NATURE'S FIELDS—*By W. P. Pycraft, Asst. Cur. Zoological Dept., British Museum*

CHARMING essays by a distinguished naturalist covering a wide and fascinating range of themes from cocoons to cats, owls to whales, pheasants to jelly fish, mermaids to horses; to appeal alike to lovers of the countryside, seashore, and garden. 90 illustrations, 206 pages, covering some 40 weekly articles which have appeared in the *Illustrated London News*.—$2.65 postpaid.

CHARLIE CHAN CARRIES ON—*By Earl D. Biggers*

ONE of the most unusual characters in this class of fiction is the Chinese detective whose Oriental philosophy appears constantly throughout the story to add an atmosphere of fatalism and keen observation. In our estimation no better stories of this kind have been written than the four that have come from the same pen. In sustained interest, amplitude of incidents, dramatic description, and careful writing, you will find this tale is hard to beat.—$2.15 postpaid.

FULL FATHOM FIVE—*By Frank H. Shaw*

THE story of five famous shipwrecks written by one who knows the sea intimately from the old windjammer days; he made four trips around the world starting as an apprentice before the mast. He has caught the tragedy, the stark reality of fatality, as well as the God-given heroism which has attended the majority of shipwrecks and made for itself a creed than which the annals of religion itself can find no better example. A fine group of authentic stories with 20 halftone page illustrations. But why, oh why the untidy, untrimmed edges in a book of such otherwise commendable format?—$3.20 postpaid.

KNOW THE FORD—*By Murray Fahnestock*

THIS is frankly a 96 page pamphlet giving the engineering points of excellence and comparison with other cars. It is an unusual presentation but extremely lucid and conclusive so that the layman in mechanics can easily acquire a thorough knowledge of the mechanisms, the reason for their design, and how they operate.—$2.10 postpaid.

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CHEMICAL PATENT DEDICATED TO PUBLIC INVOLVED IN SUIT

A RECENT decision in a patent infringement suit brought by the Selden Company against the National Aniline and Chemical Company has attracted considerable interest in the chemical industry. Two patents were involved. The first patent covers a process for making phthalic anhydride, phthalic acid, benzoic acid, and naphthaquinones now used in a variety of industries—notably for the manufacture of dyes, medicinal products, plasticizers for nitrocellulose lacquers and artificial resins—and the second patent covers apparatus for carrying out the process, controlling the generating heat, and bringing about reactions of gases.

Both patents were granted without payment of statutory fees by the inventors under the act of March 3, 1883, which provides that any employee of the Government, other than of the Patent Office, may obtain a patent for an invention without payment of the fee required by law, provided that the inventor agrees that the patent when issued can be used by the Government or by anyone in the United States without payment of royalty.

When both inventions were conceived and perfected the patentees were employed as chemists in the United States Department of Agriculture and the evidence at the trial was clear that they considered they had dedicated their rights entirely to the public. However, before the patents had issued, they attempted to make an assignment to the Selden Company, who set up various defenses including some apparently conflicting decisions to justify their belief that they had a proper right under the patents and could prevent their infringement by others.

The court held, however, that the intention of the parties to dedicate their rights to the public was clear and that "the public" meant not only employees of the Government but the general public, and therefore the assignment to the Selden Company conveyed no rights, and everyone had an equal right to use the invention without payment to the inventors or any of their alleged assignees.—*A. E. B.*

UNUSED MARK DENIED REGISTRATION

IN *ex parte* Union Co-operative Insurance Association, First Assistant Commissioner Kinnan held that the Union Co-operative Insurance Association, of Washington, D.C., is not entitled to register, under the Act of 1905, as a trademark for printed books, pamphlets, circulars, and so forth, a mark consisting of the representation of a seal impressed in wax including concentric circles between which are written the words "Union Co-operative Insurance Association 1924" and within the inner circle the words "Union Life Insurance For Union Men, Their Families and Friends."

The ground of the decision is that there is no evidence presented that the matter above described was ever used as a trademark.

In his decision, after noting the statement of the examiner, that a large variety of specimens such as leaflets, post cards, and so forth, and a copy of a periodical entitled *Official Organ of the International Electrical Workers and Operators Published Monthly* had been filed; noting further that the alleged trademark appears on the inside of the cover of the periodical in connection with an advertisement of an insurance association and that this periodical contains general reading matter and many advertisements having nothing to do with insurance associations, the First Assistant Commissioner said:

"The various leaflets, post cards, and folders submitted as specimens are mere advertisements of insurance business, intermittently, irregularly, or sporadically issued and distributed indiscriminately without any thought of remuneration. The alleged mark is not, in consequence, used on these leaflets, post cards, and folders in connection with the sale of anything nor is it used in the journal as a name or device indicating the journal. The examiner has held that this use of the particular design is not a trademark use at all in connection with any of the specimens filed. His conclusion is deemed sound."

WHEAT PRODUCT TRADEMARKS

IN a recent decision, First Assistant Commissioner Kinnan held that the J. T. Fargason Grocer Company, of Memphis, Tennessee, is not entitled to register the term "Omega" as a trademark for macaroni, spaghetti, noodles, corn flakes, and rolled oats in view of the prior registration by the H. C. Cole Milling Company, of Chester, Illinois, of that term as a trademark for wheat flour and that the registration which the Fargason Company had obtained under the Act of 1905 should be cancelled.

The ground of the decision is that the goods of the parties are of the same descriptive properties and that the fact that the use by the Fargason Company was known to the officials of the Cole Company is no ground for refusing cancellation.

OLIVE OIL URGED AS MOTOR LUBRICANT

LUBRICATING oils and greases produced from olive oil in Spain are reported by Spanish experimenters to have shown satisfactory results in preliminary tests with motor vehicles and electric motors, according to a report from Consul Austin C. Brady at Malaga, made public by the Department of Commerce.

An appeal is being made to Spaniards to use the domestic product in place of imported mineral lubricants, imports of which are recorded at 64,022,232 pounds for 1928, a large share of which was supplied by the United States. Statistics of the Petroleum Monopoly place 1929 sales of mineral lubricants at 75,387,778 pounds.

PETITION FOR CANCELLATION DISMISSED

IN the case of the Texas Ichthyol Chemical Company *versus* Ichthyol-Gesellschaft, Cordes, Hermanni and Company, Cancellation No. 1085, First Assistant Commissioner Kinnan held that the petitioner for cancellation, the Texas Ichthyol Chemical Company (Texas Ammonium Ichthyolate Co., Substituted), of Burnet, Texas, was properly permitted to dismiss without prejudice its petition for cancellation.

In his decision the First Assistant Commissioner noted the arguments that had been presented and, after stating the appellant had set forth categorically the usual reasons that the federal courts have deemed persuasive in permitting, or refusing to permit, the plaintiff to dismiss the bill without prejudice, said:

"It may be said that none of the six reasons recited on page 12 of appellant's brief as having been relied upon by courts in denying similar motions is so far present in the case at bar as to justify the refusal of the petitioner's motion and the reversal of the decision of the examiner of interferences upon it. Clearly enough the appellant has sought no affirmative relief and nothing in the nature of a cross bill has been presented. It is not clear the appellant would be injured or prejudiced by the granting of the motion beyond the possible annoyance of renewed litigation.

"It is true such judgment would bar renewed proceedings of this character but the disposition of motions to discontinue has not, in equity proceedings, usually been influenced or determined by this consideration."

With reference to the argument that a question of public policy was involved and that the case was "ripe for decision" he said:

"It is not thought there is any public policy involved in the instant proceedings or, if there is any, it is too remote to be considered. As to the testimony being closed, the case being ready for final hearing, or, 'ripe for decision,' it is believed even if these matters are admitted to be true, they are not sufficient to bar the petitioner the grant of its motion to discontinue."

TOBACCO PIPE PRODUCTION LOWER

SMOKERS in the United States are forsaking the pipe, apparently, judging by production figures for last year, according to a statement Sept. 11 by the Assistant Chief Statistician of the Census of Manu-

factures, John F. Daly. The statement follows in full text:

That American smokers are forsaking the pipe, the historical, the original and probably the most leisurely manner of smoking, is indicated by census figures.

According to the preliminary census of manufacturers' statistics the production of tobacco pipes last year showed a decline of 25.1 percent as compared with the production in 1927. The total shipments or deliveries of tobacco pipes in 1929 by manufacturers in the United States were valued at 5,202,185 dollars, as against 6,946,576 dollars reported for 1927, the last preceding census year.

The pipe production in 1927 also represented a slight decline as compared with the 7,298,595 dollar total for 1925, and this in turn was materially lower than the 9,704,816 dollars reported for 1923.

Other figures on the industry for 1929 were also in keeping with those on production. Only 22 establishments were engaged primarily in the production of tobacco pipes last year, which number shows a decline of one as compared with 1927. The 22 manufacturers gave employment to 1667 wage earners, to whom they paid 1,994,057 dollars in wages, which represented decreases of 7.7 percent and 14.7 percent, respectively, as compared with 1807 wage earners and 2,278,537 dollars paid in wages in 1927.

For materials, containers, and electric current, the manufacturers paid 1,716,788 dollars, a decrease of 36.9 percent as compared with 2,722,706 dollars in 1927. The value added by manufacture (value of products, less cost of materials, and so forth) also showed a decline, being 3,751,898 dollars as against 4,551,100 dollars in 1927, a decrease of 17.6 percent.

Of the 5,202,185 dollars' worth of pipes produced last year, briar pipes totaled 4,530,464 dollars and corncob 556,031 dollars, while other pipes produced were valued at 115,690 dollars, and other products at 266,501 dollars.

DESCRIPTIVE MARKS DENIED

IN *ex parte* J. B. Martin Company, First Assistant Commissioner Kinnan held that the company is not entitled to register, under the Act of 1905, the word "Opalescent" as a trademark for silk velvets and velvets of silk and rayon, since this word is merely descriptive of the goods.

In his decision, after referring to the dictionary definition of the word "opalescent," the First Assistant Commissioner said:

"It is well known that the goods to which the applicant applies the notation, when considered as piece goods, are made in different colors and frequently possess the property of reflecting light at different angles with a kind of iridescence which, in some instances, may be fairly well termed 'opalescent.' The word is a common descriptive word in our language and any part of the public should be permitted to use it in connection with goods of this character and no one should be permitted its exclusive appropriation."

In another decision affecting the same company, Dr. Kinnan held that they are not entitled to register, under the Act of 1905, the term "Chinchilla" as a trademark for silk velvets and velvets made of silk and rayon, since the term also is merely descriptive of the goods.

In his decision, after noting that the examiner had relied upon certain decisions in support of his holding that the goods of the applicant are of the same descriptive properties as woolen piece goods or thick heavy cloth from which coats are frequently made, and noting applicant's argument that the name as defined in the dictionary is the name of a South American rodent or its fur and at the most would be merely descriptive of applicant's goods, the First Assistant Commissioner said:

"It is held, since this word has long been used to describe a fabric made somewhat in imitation of the fur of the animal, purchasers would be led to believe the applicant's goods were likewise made in imitation of the fur and would interpret the term as merely descriptive of the fabric. The term having been for so long a time applied to a fabric in a descriptive sense, it is deemed the applicant is properly held to be seeking registration of a mark which is merely descriptive of the character or quality of the goods."

RUBBER TIRES vs. RUBBER BELTING

FIRST Assistant Commissioner Kinnan recently held that the holding in a prior decision that C. Kenyon Company, Inc., of New York, New York, is not entitled to register a trademark for vehicle tires in view of a prior registration by the Goodyear Tire and Rubber Company of substantially the same mark upon belting, should be withdrawn in view of the registrant's statement that it had no objection to such registration and it was not deemed that there would be any confusion by the use of the mark on the different goods.

He further held that, since the refusal of registration had been made in the same decision in which the opposition to the registration had been dismissed, it was believed that, now that the mark was held registrable, the opposition should be reinstated to the extent that a new decision should be rendered which would give the opposer an opportunity to appeal if it so desired.

D. A. R. OPPOSES TRADEMARK

IN the case of National Society of the Daughters of the American Revolution *versus* T. Buettner and Company, Inc., First Assistant Commissioner Kinnan held that the latter is not entitled to register, as a trademark for fabrics upon which are stamped embroidery patterns, a mark consisting of the following notation, arranged as shown:

D
WEAVE
R

The ground of the decision is that the mark so suggests the name of the opposer as to be unregistrable.

In his decision he noted that the opposer organization is frequently referred to as "The D. A. R." and also noted the prohibition of the statute against the registration of names, and so forth, of any organization, and so forth, incorporated in any state and the provision of the Trademark Act that the word "states" includes the District of Columbia and that the opposer was incorporated in the District of Columbia.

He then said:

"In a proceeding where an opposer of this character is involved, public policy as well as the statute and the settled practice justifies waiving all doubts against the applicant. There appears to have been no satisfactory reason for making so prominent these letters "D A R" which it is a matter of common knowledge have come in substantially all parts of this country and among all classes to indicate the opposer society."

He then stated that irrespective of what might have been the applicant's intent: ". . . it is believed there is a probability of purchasers or customers attaching some significance to the use of these three letters and being misled into the belief that the opposer society indorsed or approved of the applicant's goods. Any such interpretation of the applicant's mark would damage the opposer since its name would be to that extent degraded to the level of commercial activities."

RUG ANCHORS

IT was recently held by First Assistant Commissioner Kinnan that The Hoover Company, of North Canton, Ohio, is not entitled to register the notation "Anchorug" as a trademark for a dressing to be applied to the back of a rug to prevent slipping and curling, in view of the prior adoption and use by the E. I. duPont de Nemours & Company, of Wilmington, Delaware, of the notation "Rug Anchor" as a trademark upon materials preventing rugs from slipping.

The ground of the decision is that the goods are of the same descriptive properties and the marks confusingly similar as applied thereto.

In his decision, after stating that the opposer had used the mark upon a sheet or mat, on one surface of which was placed an anti-slipping composition, the mat being adapted to be placed under a rug with the anti-slipping surface in engagement with the floor, while applicant's goods are in the nature of a liquid dressing to be applied to the rugs, and noting that the goods are physically unlike in appearance, the First Assistant Commissioner said:

"The goods of the parties would, clearly enough, not be confused by purchasers. They are, however, for the same general purpose of preventing by anti-slipping composition the slipping of the rug. In the one case the material is spread directly upon the rug and dries to a suitable consistency, while in the other case a similar composition as to function and purpose is spread upon the fabric, which in turn is made to engage the rug upon its other surface. It is deemed quite probable that anyone familiar with the opposer's goods, and seeing those of the applicant on the market, would be led to conclude the latter were produced by the opposer. That confusion of origin would result if the respective marks appeared in the same market upon the respective goods seems a fair conclusion."

With respect to the marks, he said:

"As to the marks themselves, that of the applicant is practically a mere reversal of the two words adopted by the opposer. There seems to be no reason why, if the applicant did not wish to obtain some advantage from opposer's commercial activities, the applicant selected a mark so nearly identical with that of the opposer."

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Western Advertising Representative: Los Angeles, San Francisco, Seattle, and Atlanta

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Formerly Munn & Co., Inc., 24-26 West 40th Street, New York

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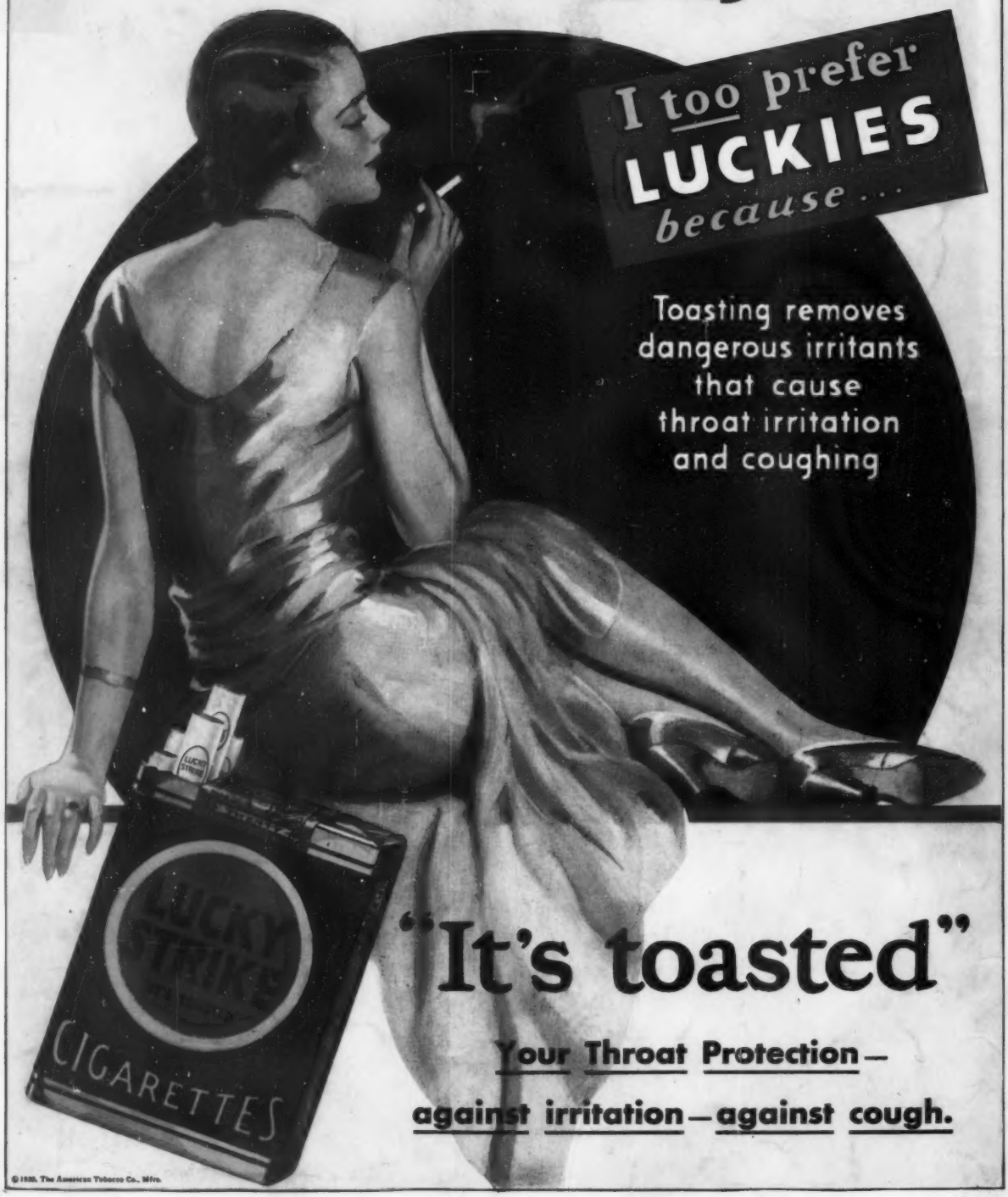

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